Social and Economic Research Project Reports *No. 5*

Costs and Performance of Malaria Surveillance and Monitoring in Thailand: A Retrospective Study Based on Apportionment of Expenditure Under Budget Headings

Final Report of a project supported by the TDR Social and Economic Research Component

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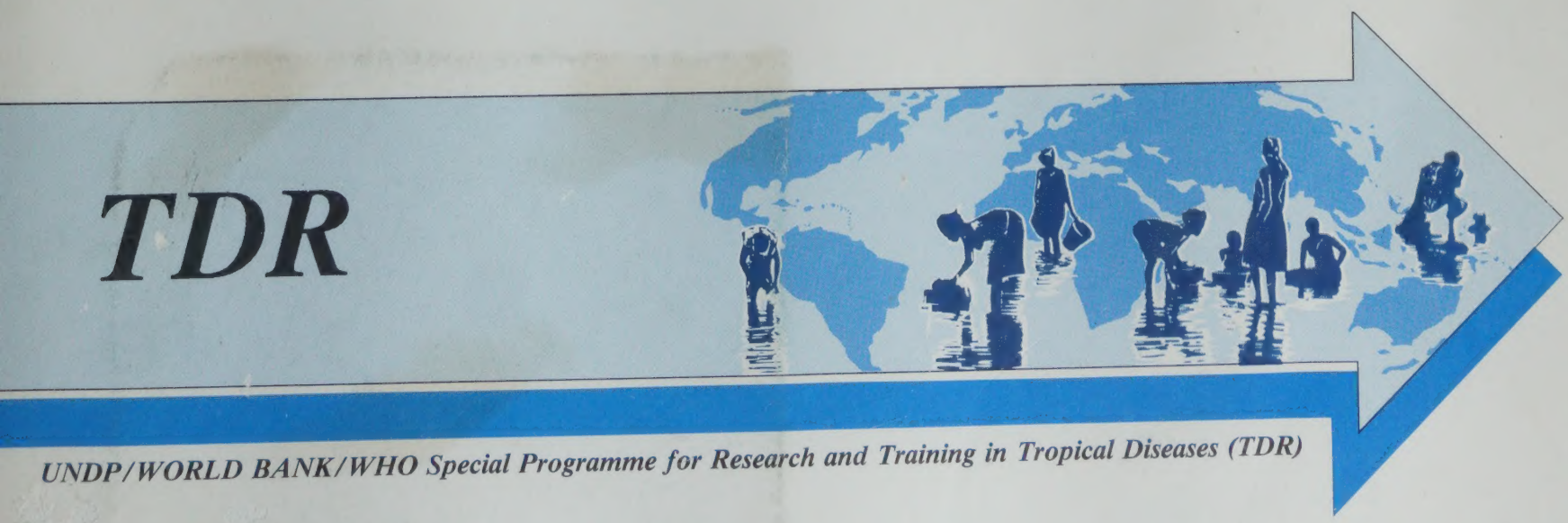

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UNDP/WORLD BANK/WHO Special Programme for Research and Training in Tropical Diseases (TDR)

TDR/SER/PRS/5

SER Project Reports appear as part of a series of unedited final reports resulting from projects supported by the UNDP/WORLD BANK/WHO Special Programme for Research and Training in Tropical Diseases (TDR). These reports are submitted to the TDR Steering Committee on Social and Economic Research for review and evaluation upon completion of a project. Project reports included in this series have not been published in their entirety elsewhere.

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Foreword

The UNDP/WORLD BANK/WHO Special Programme for Research and Training in Tropical Diseases (TDR) is a globally coordinated effort to bring the resources of modern science to bear on the control of major tropical diseases. The Programme has two interdependent objectives:

- To develop new methods of preventing, diagnosing and treating selected tropical diseases, methods that would be applicable, acceptable and affordable by developing countries, require minimal skills or supervision and be readily integrated into the health services of these countries;

- To strengthen -- through training in biomedical and social sciences and through support to institutions -- the capability of developing countries to undertake the research required to develop these new disease control technologies.

Research is conducted on a global basis by multidisciplinary Scientific Working Groups on the six diseases selected for attack: malaria, schistosomiasis, filariasis (including onchocerciasis), the trypanosomiases (both African sleeping sickness and the American form, Chagas' disease), the leishmaniases and leprosy. Scientific Working Groups are also active in the "trans-disease" areas of biological control of vectors, epidemiology, and social and economic research. The training and institution strengthening activities are limited to the tropical countries where the diseases are endemic.

The *Social and Economic Research Project Reports* series represents a new communication venture undertaken by TDR's Social and Economic Research (SER) Component. This series has been launched to facilitate and increase communication among social scientists and researchers in related disciplines carrying out research on social and economic aspects of tropical diseases and to disseminate social and economic research results to disease control personnel and government officials concerned with improving the effectiveness of tropical disease control.

Research reports published in this series are final reports of projects funded by TDR and usually include more material than ordinarily published in peer review journal articles. TDR considers this material to be valuable both for investigators involved in the study of social and economic aspects of tropical diseases and for professionals involved in training programmes in the social sciences, economics and public health. The series should acquaint those working on similar problems with approaches undertaken by others, in order to test new approaches in different settings, and should provide useful information to personnel in disease control programmes and related agencies.

All requests for further information should be addressed to: Dr C. Vlassoff, Secretary, Steering Committee on Social and Economic Research, TDR, World Health Organization, 1211 Geneva 27, Switzerland.

Tore Godal, Director

Special Programme for Research
and Training in Tropical Diseases
TDR

PREFACE

Since 1979 the Social and Economic Research (SER) Component of the UNDP/WORLD BANK/WHO Special Programme for Research and Training in Tropical Diseases (TDR) has been supporting research aimed at improving the effectiveness of disease control programmes through the incorporation of social, cultural and economic factors into the design and implementation of control programme activities. In aiming towards this overall final objective, two intermediate objectives guide TDR´s social and economic research activities:

- To determine the impact of social, cultural, demographic and economic conditions on disease transmission and control.
- To promote the design and use of cost-effective and acceptable disease control programmes and policies.

The study conducted by Professor Somkid Kaewsonthi and her research team is related to the second intermediate objective of SER since it examined the costs and performance of malaria control in the Malaria Division of the Ministry of Public Health in Thailand. The project aimed to assist the malaria control programme managers to apply economic concepts and tools to the monitoring and evaluation of its activities. It also provided data on costs and performance which could be used by the malaria programme to improve its services and practical recommendations for the Malaria Division. An equally important aspect of the study was its assessment of costs to patients receiving the services and of their behaviour in seeking medical attention.

Professor Somkid´s study, completed in 1983, has proven most significant for a number of reasons. Firstly, the research team worked closely with the Malaria Division which considered the research findings to be relevant and useful. Secondly, it is one of the few studies to examine in an exhaustive way the costs of providing malaria services in relation to the performance achieved. Thirdly, the project has had important multiplier effects in terms of further research and training on the economic aspects of tropical diseases in Thailand and elsewhere.

Carol Vlassoff, Secretary
Scientific Working Group and Steering Committee
on Social and Economic Research

Special Programme for Research
and Training in Tropical Diseases
TDR

Acknowledgements

The research described in this report has proved to be more demanding, frustrating and fascinating than I had ever imagined.

Many people, from field workers to WHO experts have contributed to the outcome. My thanks to all of them for my education in the realities of health economics research.

I wish to thank the UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases for funding the project, for investing in an untried and inexperienced Principal Investigator. The production of competent researchers in developing countries depends on such pump priming investment. Among many WHO staff who have been constant in their encouragement and constructive criticism, three people have been particularly supportive: Dr P. Rosenfield, Secretary of the SER TDR Steering Committee, Dr Peter Beales of the Malaria Action Programme and Dr Brian Doberstyn, resident WHO Senior malariologist in the Malaria Division, Bangkok.

Successful completion of this research would not have been possible without the total cooperation of the Malaria Division in Thailand. In particular I wish to thank Dr Surin Pinichpongse, Director of the Division, for encouraging and supporting the study and Dr Somthas Malikul, Director of Region 1 for being sufficiently open-minded to welcome and facilitate an investigation into the cost and performance of two Zones in Region 1. Dr Somthas had the patience to guide me through an education in malaria surveillance, to provide ideas on how studies might be undertaken and to arrange for the active participation of zone chiefs and field personnel in the collection of data.

Among the many people who gave time to reading the final draft, I wish to thank Miss Mary Ettling a Peace Corps Volunteer working with the Malaria Division for her diligence and kindness in suggesting how improvements could be made. My thanks also to Mrs Elaine Robinson, University of Bradford for her competence and commitment in preparing many draft type scripts.

Last, but by no means least, I wish to thank Dr Alan Harding who, as a constant friend and colleague, learned with me, provided insights when most needed and worked for long hours to improve the quality of my analysis and the nature of this and earlier reports.

Judgements about the quality and relevance of this research must rest with staff of the Malaria Division in Thailand and the WHO in Geneva. For myself, after two and a half years' experience, I know I could and would do a better job were I to start again.

Somkid Kaewsonthi
Principal Investigator
May, 1983

CONTENTS

1. INTRODUCTION

1.1 Project Objectives

The initial aim of the project was to determine HOW the cost effectiveness of malaria surveillance and monitoring measures might be undertaken so that malaria managers could evaluate their activities and make the best use of resources available.

Specific objectives of the project were:

1) Prepare a cases study of the cost effectiveness of malaria surveillance and monitoring measures which could be used in compiling a manual on cost effectiveness analysis.

ii) Assist malaria disease managers through the application of economic concepts and tools.

iii) Strengthen research capability in health economics at Chulalongkorn University, Bangkok, Thailand.

The project emerged in response to the expressed needs of three institutions; Chulalongkorn Univeristy, the WHO Scientific Working Group on Social and Economic Research, and the Malaria Division of the Ministry of Public Health in Thailand.

Chulalongkorn University expressed the need to strengthen its teaching and research capability in health economics and to apply health economics to good effect in Thailand.

The Scientific Working Group on Social and Economic Research of the UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases expressed the view that case studies of the cost effectiveness of disease control programmes should be undertaken and used in compiling a manual on cost effectiveness analysis (WHO 1979).

The Malaria Division of the Ministry of Public Health in Thailand also expressed an interest in the development of a cost effective malaria case detection and monitoring system as part of its applied research programme (Malaria Division 1980).

As the project progressed it became clear that cost effectiveness of malaria surveillance and monitoring could not be studied retrospectively. The aims of the project were therefore amended:

i) Prepare a case study on the cost and performance of malaria surveillance and monitoring measures which could be used in compiling a manual on cost and performance analysis.

ii) Assist malaria disease managers through the application of economic concept and tools.

iii) Strengthen research capability in health economics at Chulalongkorn University, Bangkok, Thailand.

Reasons for amending the original aims warrant explanations. The concept of cost effectiveness is deceptively simple and intellectually attractive as a management tool. But it is doubtful if cost effectiveness within our definitions of effectiveness and efficiency is of real relevance in studies to improve the efficiency of disease control and health care processes.

In economic terms cost effectiveness requires measurement of the costs of two or more alternative processes in achieving a pre-determined level of effectiveness in order to identify which of the processes is more cost effective. (Effectiveness (%) expresses the relationship between the outcomes from a process and a target set. A process is defined as a combination of inputs or activities).

Comparison to determine which of two or more processes is the more cost effective is only valid if the processes are true alternatives, if the processes achieve the same percentage effectiveness given the same target and, if conditions are the same for the processes.

Many papers on so called cost effectiveness assume that processes being compared have the same target and achieve the same level of effectiveness. What is frequently measured is cost per case and not cost effectiveness.

The cost effectiveness of surveillance and monitoring by operational services in one area cannot be measured retrospectively because operational services are complementary rather than alternative and because targets and effectiveness achieved will not be the same. Nor can the cost effectiveness of the same type of operational service in different sectors or zones be measured retrospectively because targets and achievements will not be the same and because conditions such as cases existing, geographical features, population density and migration differ in each sector and zone.

Research undertaken in this project is not therefore a conventional study of cost effectiveness. Even if cost effectiveness studies could be made, after careful planning of experiments, it is doubtful if the results would be of use to malaria managers. What is examined in this report is HOW to measure the cost and HOW to measure the performance of malaria surveillance and monitoring measures. Percentage effectiveness is one of the many measures of performance used in the study.

It is to be noted that staff of the Malaria Action Programme of the World Health Organization use the concept of operational efficiency as the degree of application of a particular technology and effectiveness as the degree to which malaria responds to that technology.

We found much confusion in economics and medical science literature concerning the meaning of effectiveness and efficiency. We hope our broader concern with measures of performance will provide a clear and acceptable framework which can be understood and used to advantage in both disciplines.

1.2 The Anti-Malaria Programme

Malaria eradication and control

The WHO and Government of Thailand signed an agreement in 1965 to cooperate in a Malaria Eradication Programme for the country. The Malaria

Eradication Strategy required "The ending of transmission of malaria and the elimination of the reservoir of infective cases, in a campaign limited in time and carried to such a degree of perfection that, when it comes to an end there is no resumption of transmission" (Beales 1978).

Malaria eradication was phased in four stages

Preparation	- initial survey; - planning; - preliminary operations;
Attack	- total coverage of measures to interrupt transmission and deplete the parasite reservoir;
Consolidation	- cessation of regular anti-malaria measures; strict case finding and rapid remedial measures until 3 years of active surveillance have shown the absence of new indigenous cases;
Maintenance or Partial integration	- this phase which begins when the criteria of eradication are met and continues until global eradication is achieved.

It became apparent in many countries in the late 70's that malaria eradication, in the formal sense, could not be achieved. As a result, in 1977 the Malaria Division in Thailand began a less ambitious but more realistic Anti-Malaria Programme based upon a malaria control philosophy.

Malaria control has as its ultimate goal the elimination of the disease. But the Malaria Control Strategy recognizes that the prevalence of the disease should be reduced to where there is no longer a major public health problem (a tolerable risk to the health of the population) taking into account the local conditions and the best that one can achieve with the available means (Beales 1978).

Areas in Thailand are now designated as control or eradication with the latter subdivided into late attack, consolidation or partial integration phases. In 1981, populations under the various phases were:

Phase	Population	% of Total
Control	10,160,046	22.67
Eradication	34,025,087	77.33
- Late attack	12,764	0.03
- Consolidation	1,701,372	3.80
- Partial Integration	32,940,968	73.50
Total	44 185 133	100.00

Surveillance and monitoring

Comprehensive antiparasite and antivector measures are provided in Thailand by the Malaria Division of the Department of Communicable Disease Control, Ministry of Public Health. The Malaria Division administers antivector and antiparasite measures through five regional offices. Each of the five regions are subdivided into zones. Each zone is further subdivided into sectors (Table 1).

Local hospitals supplement the work of the Malaria Service by providing passive case detection (PCD), treatment and the reporting of positive cases to the relevant zone office of the Malaria Service. Suspected or known cases may also be referred to hospitals for treatment. Village health centres (VHC) (health centres and midwifery offices), part of the medical service, function like malaria village volunteers (MVV) collecting blood samples and providing presumtive treatment. The monitoring system operated by the Malaria Service is detailed in Table 2.

Surveillance was originally defined as "that part of the Malaria Eradication Programme aimed at the discovery, investigation and elimination of continuing transmission, the prevention and cure of infection, and final substantiation of eradication" (WHO 1963).

Surveillance embraces a number of activities; the detection of malaria infection in a community by parasitological examination of blood from people with fever, a history of fever or headaches, history of travel to another area, or anyone who desires to "check" his blood; antimalarial drug treatment, presumptive and/or radical; epidemiological investigations; and implementation of the required remedial or preventive measures (WHO 1957).

Monitoring is the system developed for recording the nature and outcome of surveillance activities. The records provide information on which decisions affecting surveillance activities may be based.

In the change from an eradication to control strategy the general concept of surveillance remains the same but the objectives, structures, content and manpower used for specific activities have changed. Systems for recording the nature and outcomes from surveillance have not always been modified.

Case detection in surveillance aims at the collection and early examination of blood smears from patients with a recent history of fever or suspected of having malaria. Collection may be made through static agencies, termed passive case detection (PCD), when patients call at a hospital clinic, malaria clinic (MC) or village health centre (VHC) or at a malaria post staffed by a malaria village volunteer (MVV). Collection may also be made through regular domiciliary visits termed active case detection (ACD) and through special surveys.

Where diagnosis cannot be made immediately, through microscopic examination of a blood smear, patients received a single dose presumptive treatment. Presumptive treatment provides, in principle, clinical relief from symptoms and renders the patient non-infective to anophelines for a few days. Patients found to be infected on examination of the blood slide (positive cases) are provided with a radical drug treatment or referred to hospital.

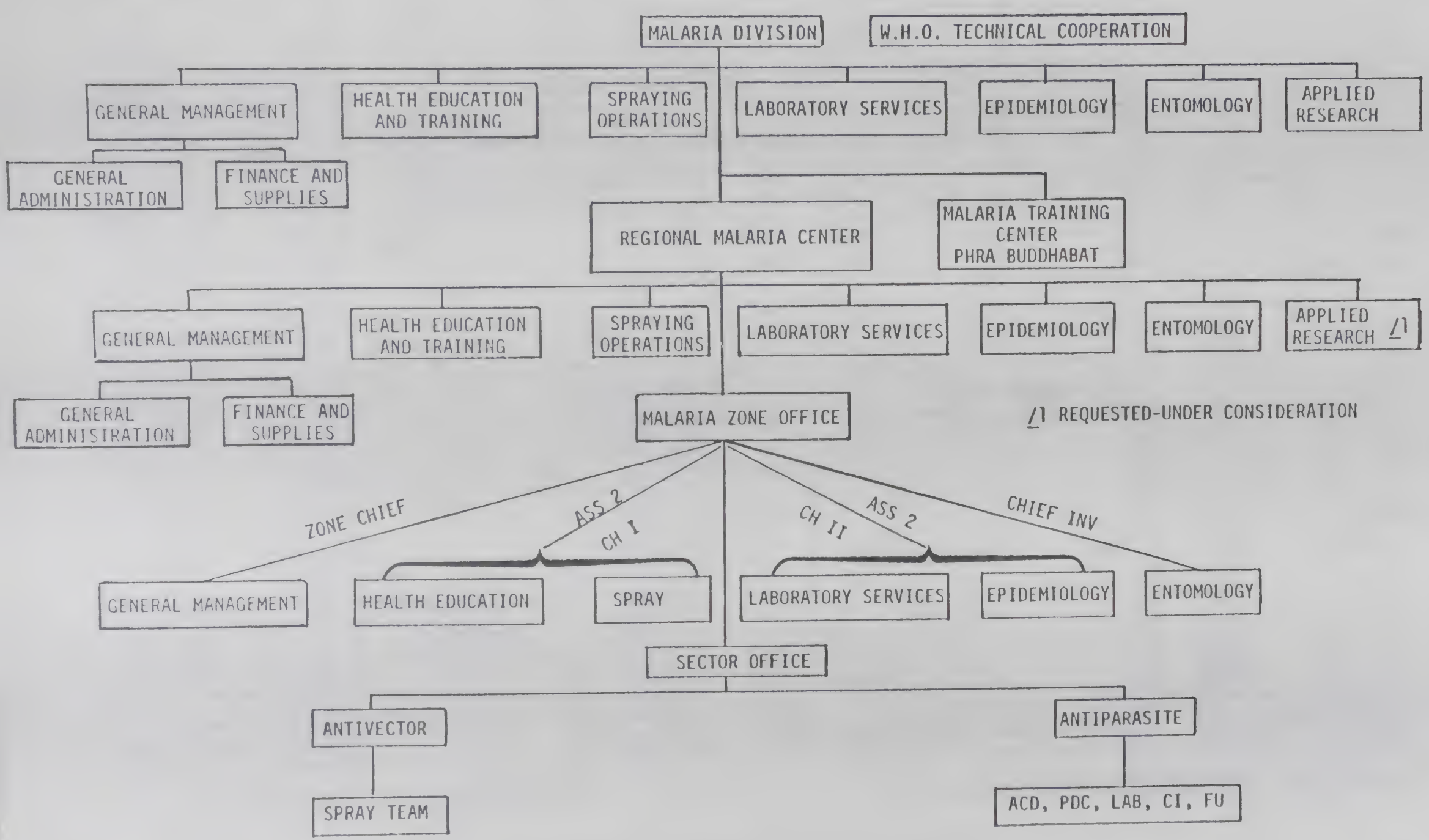
Surveillance also includes epidemiological investigation of cases to determine the type and origin of infection, occasional remedial local insecticide spraying in eradication areas and, where appropriate, mass drug administration to eliminate or prevent transmission.

The nature and objectives of surveillance activities are linked to the strategy employed; control or eradication.

For example ACD in an eradication area is to help ensure final detection and treatment of a few remaining cases; used in a highly malarious control area it is an adjunct to other case detection activities.

TABLE 1

ORGANISATION AND ACTIVITIES OF THE MALARIA SERVICE

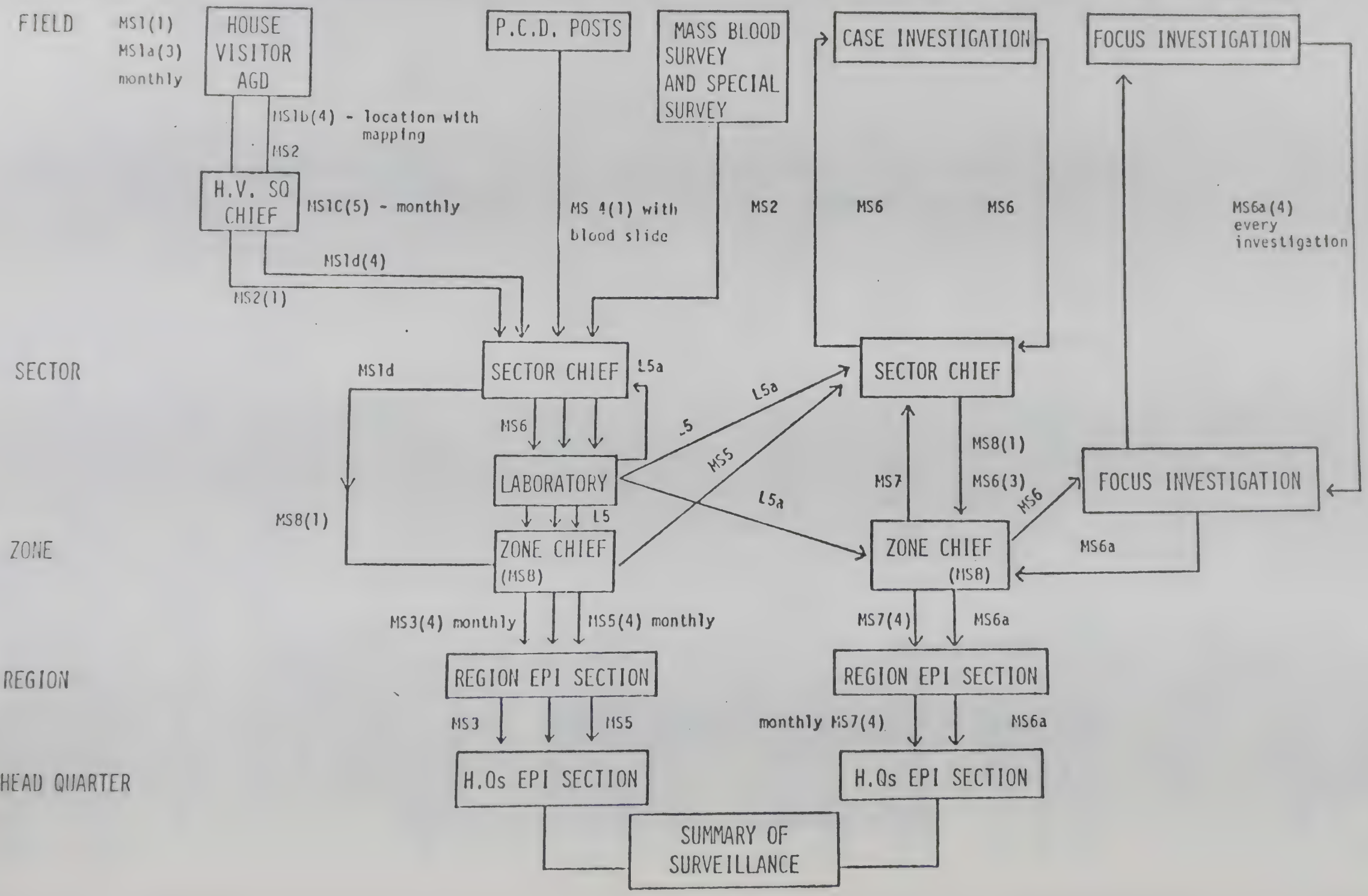


/1 REQUESTED-UNDER CONSIDERATION

MONITORING DURING SURVEILLANCE OPERATION

I REPORTING ON WORK PERFORMANCE

II ACTION ON AND REGISTRATION OF CASES AND FOCI



ACD is a requirement in some eradication areas and a not very highly recommended alternative in control areas. The performance of ACD will therefore be affected by its function as well as the quality of management.

PCD in an eradication area is part of a process of integration of services (Malaria Division and Primary Health Care) for case detection and a network to maintain low level vigilance against a return of malaria; in control areas it is the main tool of case detection required through malaria village volunteers in every village.

Case investigation and follow-up are formally required in eradication areas; both are optional in control areas. Local spraying is also a required element in certain eradication areas but an option in control areas.

This research was only concerned with the antiparasite measures of surveillance and monitoring. No study was made of the costs or performance of antivector measures.

1.3 Methodology

1.3.1 Zones studied

Zones 3 and 7 in Region 1 were selected for study. Region 1 is responsible for operations in twelve provinces covering 113,646 square kilometers from Tak province on the Burmese border to Sri Saket province, bordering Kampuchia. The population of 9 million people is distributed among the 12 provincial capitals, 129 district towns and 11,765 villages. Of the population 88% are in eradication areas and 12% in the largely mountainous and border areas under control.

The comparative characteristics of Zones 3 and 7 are presented in Table 3.

Zone 3 Saraburi is located in Phra Bhuddhabat between the provincial capitals of Saraburi and Lopburi. the eight sectors of the zone service some 1,021,000 people in what was formerly a highly malarious area. Over half the population now live in areas where spraying is no longer necessary.

Zone 3 is largely flat plain with two districts Kangkoi and Chaibadan with wooded mountains and a high incidence of malaria.

Zone 7 Pakchong is responsible for malaria operations in six districts of Saraburi and Nakon Ratchasima Provinces, an area of 8,847 square kilometres with a population of over 560,000. Pakchong and the surrounding district have been considered to be highly malarious. There are 650 villages in the zone of which 240 are in control areas. The climate is cool and dry.

A major obstacle in the control of malaria in Zone 7 is the geography of the area; plains, forested foothills and mountains. Vector breeding sites are widespread particularly in the fringes of the forested hills. Settlements in these areas maintain malaria transmission with trips into the forest carrying malaria into other areas.

Another problem is the mobility of the population. Seasonal agricultural workers and "pioneers" import and export malaria on a major scale. Positive cases in the population are therefore hard to treat and to follow. Since many residents maintain a household in their original home to which they return

TABLE 3

ZONES 3 AND 7 REGION 1 JANUARY - DECEMBER 1980

		ZONE 3	ZONE 7
AREA : Square kilometers			
	Total (All phases)	9,063	8,122
	Control Phase	4,207	4,669
	Consolidation	1,015	1,114
	Partial Integration	3,841	2,339
POPULATION			
	Total (All phases)	1,034,369	507,981
	Control	135,736	241,626
	Consolidation	98,148	11,846
	Partial Integration	800,485	254,50[illegible]
TOTAL BLOOD SLIDES EXAMINATION (By major services)			
	ACD	21,423	66,884
	Malaria Clinics	17,049	27,580
	Malaria Village Volunteers	19,535	20,223
	Village Health Centres	7,880	6,952
TOTAL POSITIVE CASES (By major services)			
	ACD	146	2,054
	Malaria Clinics	4,085	6,997
	Malaria Village Volunteers	536	1,790
	Village Health Centres	202	57
Number of Malaria Volunteers		approx. 2,083	approx. 97
NUMBER OF MALARIA CLINICS			
	1980	4	7
	1981	5	10
NUMBER OF MALARIA SECTORS WITHIN THE ZONES		8	6
NUMBER OF TAMBONS (CANTON)		202 + 6 municipalities	59 + 1 municipalities
NUMBER OF VILLAGES			
	Control	209 + (part of 15V)	240
	Eradication	1513 (part of 15V)	410

regularly large proportions of the population are away from home periodically hampering ACD and spraying operations.

1.3.2 Reliability and validity of data

One of the aims of the research was to strengthen the knowledge and research capability of the research team in the field of health economics. It is not surprising therefore to find that views on concepts and methods presented in earlier progress reports were modified in the light of experience. Considered generously it may be argued that an iterative research process was followed throughout the two years of the study. Collection of data provided clearer understanding of the systems being studied and of the nature of costs and performance. Clearer understanding allowed more informed decisions to be made on what data should be collected and how the data might best be analyzed.

One of the distressing ´discoveries´ in the learning process was the low reliability of much of the data used for analysis. Efforts were made to check and cross check data, but often such checking revealed rather than resolved problems of reliability.

Low reliability does not affect the methods developed to measure costs and performance. It does raise questions about the validity of conclusions. Above all low reliability means that where regular studies of costs and performance are to be introduced simple systems must be developed, training provided and effective management applied to ensure that conclusions are based on reliable data.

A second factor recognized as the project developed was the limitations to a simple analysis of costs and performance of surveillance activities.

Direct comparison of the costs and performance of each activity fails to reflect the different objectives and different concomitant benefits each activity brings to surveillance For example, the health education and community participation role of MVV; the availability of MVV at all times; the role of ACD in maintaining important maps, village registers and house cards used in other malaria activities (spraying); importance of VHC in integration process, etc. Different surveillance modes also serve different populations of patients, different malaria situations and different geographical areas.

These factors have, of necessity, been ignored in this first study of costs and performance of malaria surveillance and monitoring. The reasons are partly technical and partly education. Technically it is almost impossible to assign costs to activities in phases retrospectively. Educationally the importance of the nature, objectives and benefits from surveillance activities only became really clear during the later stages of the study.

2. HOW TO DETERMINE THE COSTS AND PERFORMANCE OF MALARIA SURVEILLANCE AND MONITORING MEASURES

This section describes how the costs and performance of surveillance and monitoring measures can be determined. Concepts and methodology developed are derived from a study of the cost and performance of two zones within Region 1 of the Malaria Division, Ministry of Public Health, Thailand. Specific procedures used for gathering data such as questionnaires and apportionment of budgets are unique to the Malaria and Medical Services in Thailand. But concepts of cost, performance criteria and the approach to gathering data should have more general application.

Information on costs and performance should provide managers of disease control programmes with procedures for monitoring control measures so that the best use may be made of the resources available. Best use could mean the best allocation among alternative processes. Best use may also mean achieving higher efficiency (relationship of input to output) through tighter control of expenditure and/or operational procedures.

2.1 Costs

In every day usage cost is expenditure on goods and services. To an accountant costs may be sub-divided into capital and operating costs. The former may be depreciated over a number of years i.e. the value of the capital item shown in a balance sheet decreases each year. In economic terms cost may include expenditure on the activity (accounting costs) together with revenue foregone or opportunity cost (the highest valued opportunity necessarily forsaken). It is evident that the cost of an activity will depend upon the system of costing used.

2.1.1 Nature of costs

If malaria managers are to be encouraged to gather data and evaluate costs then the terminology and framework of costing should be unambiguous and closely linked to the organization and activities of the Malaria Service. Definitions of costs in this report therefore show some deviation from conventional usage.

The framework of costs is shown below.

		DIRECT COST (Direct to activity	Explicit Implicit
	INTERNAL COST (Internal to the institution)	INDIRECT COST (Indirect to activity)	Explicit Implicit
TOTAL COST			
		DIRECT COST (Direct to (Activity	Explicit Implicit
	EXTERNAL COST (External to the institution)	INDIRECT COST (Indirect to activity)	Explicit Implicit

Total Costs

Total cost of a service is the sum of designated internal and external costs.

Internal/external costs (to an institution)

Costs may be described as internal or external to the institution. What constitutes 'the institution' is defined by the analyst. In malaria surveillance the institution could be a malaria clinic, zone, region, the Malaria Division, or the Ministry of Public Health. If the costs of a malaria zone are being examined, then such items as administration at Regional and Divisional Headquarters are an external cost, i.e. external to the zone (institution).

Direct/indirect costs (to an activity)

A cost is direct if expenditure is for a specific activity, i.e. the salary of a microscopist is a direct cost of laboratory work in a zone. A cost is indirect if expenditure contributes to an activity but is not spent directly on the activity, i.e. administrative costs of a zone and contributary costs such as health education.

Explicit/implicit costs (of an activity)

A patient incurs explicit cost in travelling to a malaria clinic. Explicit costs are concerned with actual expenditure. Implicit costs are concerned with the opportunity cost of people, capital invested and the depreciation of assets. The patient incurs an implicit cost in the time cost while attending a malaria clinic.

What is actually included in the costing of a service will depend upon the aims of the analysis. For example, a planner may wish to examine the cost of alternative procedures in the microscopic examination of blood slides, i.e. whether to have the slides collected from MVV´s and brought to a static malaria clinic or whether to send a mobile malaria clinic on a circuit of MVV´s. The planner could consider the limited perspective of costs to the Malaria Division (i.e. whether expenditure by the Malaria Division could be reduced by a change in procedure) or more comprehensively the cost to society.

In the former case the cost analysis could be limited to internal direct expenditure on salaries and supplies, and internal indirect expenditure on administration, health education and research. When considering the cost to society a much broader view might be taken. External explicit and implicit costs of patients would be considered in addition to direct and indirect costs internal to the Malaria Division.

2.1.2 Expenditure

Malaria surveillance and monitoring are concerned with antivector and antiparasite measures. Regular antiparasite activities, the focus of this study, are the collection of blood slides from patients who may have malaria, microscopic examination of blood slides to determine if malaria parasites are present in the blood and to identify the species of parasites present; provision of treatment both presumptive and radical or radical only; case investigation to determine where infection occurred and potential further transmission; follow up of positive patients over a one year period to check through further blood examination that they are clear from infection; and monitoring the recording of the results of all stages of surveillance.

Surveillance is provided by seven operational services; ACD, malaria clinics, malaria village volunteers, village health centres and hospitals, mobile clinics and special teams. Each operational service provides one or more of the activities included in surveillance.

Surveillance activities undertaken by special teams from zones or sectors are termed "occasional activities" which include mass blood surveys, special surveys and mass drug administration used largely in control areas.

The goals of costing in this study are to determine the total cost of surveillance activities undertaken by each operational service and the elements of that cost. when costs are known and related to performance, malaria managers should be in a position to make informed decisions about 'best'

alternatives, and how to improve efficiency. (Efficiency is output/input i.e. the nature of the services provided for a given cost and/or the performance of the malaria service for a given cost).

Expenditure (internal explicit costs) in the Malaria Service, as in all government organizations in Thailand, is itemized under six major headings: personnel; remuneration; supplies and materials; public utilities; welfare expenditure; and buildings and fixed assets. Subdivisions of these headings and the meaning for each subdivision are detailed in Table 4. The Malaria Service (a Division of the Ministry of Public Health) receives an annual budget with amounts assigned to each heading. The Division allocates budgets to the five Regions which in turn allocate budgets to Zones.

The Division, Regions and Zones each expend the budgets provided on operational units. Operational units at Divisional and Regional Headquarters are: Administration, Health Education, Applied Research, Spraying, Entomology, Epidemiology and Laboratory Services. Zones distribute their funds to six operational units: Administration, Health Education, Spraying, Laboratory Services, combined Epidemiology and Entomology, and Treatment.

There is no clear relationship between budget headings and the operational units at Division, Region and Zone.

The six operational units at each zone use the budgets received to provide a wide range of operational activities.

Surveillance activities, a subset of these operational activities are provided through seven operational services.

The major issue in determining costs is <u>how</u> to apportion expenditure recorded under budget headings to the cost of operational units, the cost of operational services and the cost of particular activities.

2.1.3 <u>Apportionment of expenditure in the malaria service</u>

Expenditure on surveillance and monitoring by operational units, operational services and on particular activities is not directly recorded. Cost of surveillance and monitoring by-operational units and operational services must therefore be assessed by apportioning expenditure recorded under budget headings. Throughout this study expenditure refers to actual expenditure recorded in the period January to December 1981.

TABLE 4

BUDGET HEADS	
1. PERSONNEL	
1.1 Salaries and subsistance	- Salaries of civil servants and disturbance allowance
1.2 Permanent wage	- Wages of full time permanent employees who are not given positions as civil servants
1.3 Temporary wage	- Wages for full time/part time employees who lack permanent status
1.4 Allowances	- Overtime for civil servants and permanent employees
2. REMUNERATION	
2.1 Fees	- Postage and telephone charges
2.2 Freight	- Transport of centrally purchased chemical spray from docks
2.3 Travelling allowance	- Per diem when travelling away from normal place of work
2.4 Transport	- Travel cost of personnel - Cost of fuel purchased in the fields
2.5 Maintenance	- Maintenance of fixed assets; buildings and fittings
2.6 Others	- Small items; each less than 1% of total remuneration
3. SUPPLIES AND MATERIALS	
3.1 Office supplies	- Papers, forms, stationery, consumables, etc.
3.2 Drugs	- Drugs for presumptive and radical treatment centrally purchased by Malaria Division
3.3 Insecticides	- Chemical spray and larvacides centrally purchased at Division or Regional level
3.4 Vehicle supplies and fuel	- Repairs and spares for vehicles - Cost of fuel provided at division, region and zone offices
3.5 Laboratory supplies	- Glass ware and chemicals centrally purchased at region or divisional level
3.7 Health Education Supplies	- Posters, printing, audio tapes; some provided centrally
3.8 Others	- Small items
4. PUBLIC UTILITIES	- Electricity and water supply (only)
5. WELFARE EXPENDITURE (Civil servants and permanent staff)	- Social welfare; payment of fees for education of children and reimbursement of medical expenses - Low income support for those receiving less than minimum daily wage rate
6. LAND, BUILDING AND EQUIPMENT	- Capital expenditure

There are five stages to the system of apportionment developed for use in this study (Table 5).

Stage 1 : apportionment of divisional, regional and zone budgets to divisional, regional and zone operational units respectively;

Stage 2 : apportionment of divisional operational unit expenditure to cost of regional operational units and zone operational units and apportionment of regional operational units expenditure to cost of zone operational units;

Stage 3 : assignment of items from operational units at division, region and zone to internal direct costs;

Stage 4 : assignment of items from operational units at division, region and zone to internal indirect costs and apportionment of indirect costs to costs of surveillance;

Stage 5 : apportionment of internal direct costs and internal indirect costs to operational services and occasional activities.

Several criteria could be used for apportionment at each stage. For example, Divisional Headquarter´s budget is apportioned to seven operational units; Administration, Health Education, Applied Research, Spraying Entomology, Epidemiology and Laboratory Services. Some items such as expenditure on chemical sprays and drugs can be allocated directly to the user units. But other expenditure such as salaries and materials has to be apportioned (allocated) to operational units using suitable criteria. Criteria which could, with some justification, be used are an´equal share to each operational unit, the proportion of all types of staff in each operational unit or the monthly salaries of all types of staff in each operational unit. Different types of criteria may be appropriate at each stage of apportionment.

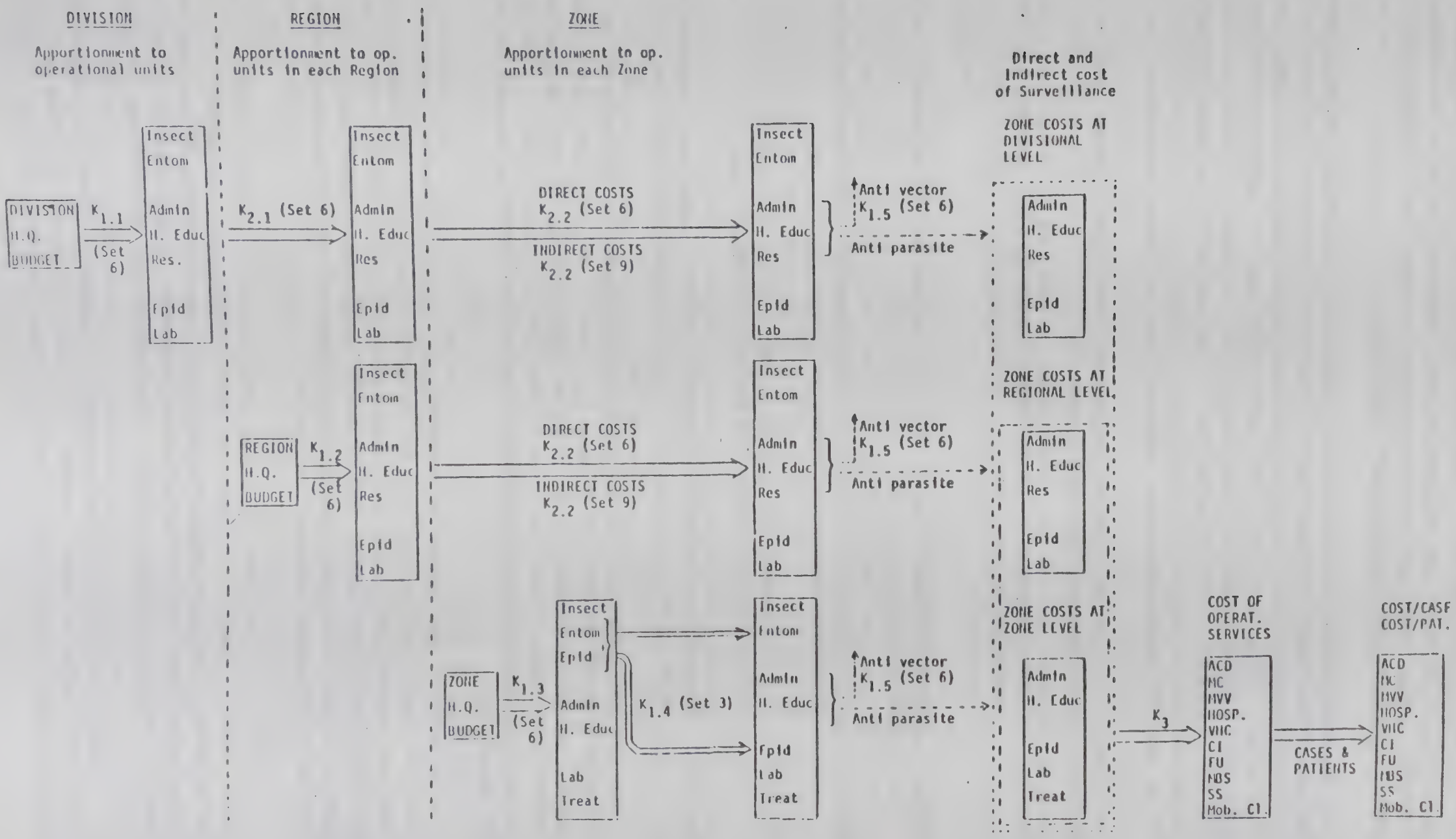
It is difficult to decide which is the most appropriate criteria to use for apportionment at each stage. A system has therefore been developed to allow study of the effects on using any combination of the criteria in sets K_1, K_2 and K_3. Using a network system and dynamic programme data can be analyzed to show the effect of different combinations of criteria on the cost of operational units, operational services and occasional activities.

The most reasonable cost (nearest reality) for operational units and operational services is determined by selecting a combination of the most suitable criteria. Maximum and minimum costs obtained on using extreme combinations of criteria can also be determined. This means that the range of possible costs and relationship between maximum, minimum and most reasonable cost can be reviewed.

The system provides for direct costs of operational units at division, region and zone levels to be expressed as expenditure under each budget heading. Costs derived from divisional, regional and zone expenditure are subdivided into direct and indirect costs. Direct costs at this stage are expressed as expenditure under each budget heading but indirect costs appear as a lump sum. Through the system, divisional, regional and zone expenditure is kept separate so that component costs can be identified at each stage.

TABLE 5

SYSTEM AND SELECTED CRITERIA FOR APPORTIONING EXPENDITURE TO SURVEILLANCE COSTS AT DIVISION, REGION AND ZONE LEVELS AND TO COST OF OPERATIONAL SERVICES



2.1.4 Apportionment of hospital expenditure

Malaria case detection (clinical or laboratory diagnosis) and treatment is provided in hospitals to inpatients and outpatients. The time, materials and resources used in the diagnosis and treatment of malaria cases is not recorded. As a result it is necessary to assess costs through apportionment of expenditure recorded under budget headings.

To explore how costs might be determined study was made of one provincial hospital (350 beds) and one district hospital (30 beds) in Zone 3. The provincial hospital was perhaps atypical in the level of malaria cases detected and treated. A major difficulty identified was the apportionment of time, particularly in the smaller hospitals. In the hospital service many members of staff are engaged in every activity. Time analysis was made through questionnaires to the staff concerned. A more reliable analysis of time can only be made through extensive observations or diary records.

There are five stages in the apportionment of expenditure to the costs of inpatient and outpatient malaria cases :

Stage 1 : Apportionment of expenditure under budget headings to the cost of administration, cost of outpatient services and cost of inpatient services.

Stage 2 : Apportionment of the cost of outpatient services to outpatient malaria cases.

Stage 3 : Apportionment of the cost of inpatient services to inpatient malaria cases.

Stage 4 : Apportionment of indirect cost : cost of administration to cost of malaria outpatients and malaria inpatients.

Stage 5 : Determination of the internal direct cost and internal indirect cost of malaria outpatients and malaria inpatients.

Different criteria can be used at each stage: criteria K_1 at stage 1; multi-dimensional indexes at stages 2, 3 and 4 and allocation of cost items at stage 5. Using the network of alternative criteria at each stage and a computer programme, data can be analyzed (as in Section 2.1.3) to determine maximum, minimum and most reasonable costs for outpatients and inpatient malaria cases.

Criteria K are based on proportions; proportions of time of doctors, nurses and assistant nurses and other staff spent on activities; proportion of outpatient visits and inpatient days; proportion of drugs prescribed to inpatients and outpatients; and proportion of inpatients and outpatients. For stages 2, 3 and 4 six multi-dimensional indexes were developed to be used as criteria in the apportionment of costs.

In stage 2, the cost of outpatient services is apportioned to outpatient malaria cases. Factors included in the indexes are the number of outpatient malaria cases, the time doctors devote to the treatment of one outpatient malaria case, the time doctors devote to outpatient services, the number of outpatient malaria visits and the total number of outpatient visits.

Similar factors are used at stage 3, apportionment of inpatient services to inpatient malaria cases; number of inpatient malaria cases and other inpatient cases, average days a malaria case is hospitalized, total inpatient

days, and the time that doctors, nurses and other staff spend on malaria cases and on all inpatients.

Apportionment of administration to inpatient and outpatient malaria cases occurs at stage 4. Factors included in the indexes are: proportion of time on outpatient and inpatient services; proportion of outpatient visits and inpatient days and proportion of outpatients to inpatients equivalents.

The inpatient/outpatient equivalence index assumes that resources used for 1 inpatient day is equivalent to 5 outpatient visits. The assumption is made on a subjective basis since time and resources did not allow for an indepth study.

2.1.5 External costs

External costs are costs external to the ´institution´. If the ´institution´ is the Malaria Division, several costs fall into this category: contributions made by aid organizations from outside the country (supportive costs); expenditure and time costs of patients; expenditure and time cost of relatives in attendance on patients; time costs of malaria village volunteers and time cost of households visited during ACD.

Supportive costs

Support from outside the country in the form of money, equipment and manpower is mainly provided by USAID and WHO. Resources may be chanelled directly to surveillance activities and operational services (explicit direct cost) or chanelled centrally to the Malaria Division (explicit indirect cost). Where central provision is made explicit indirect costs are apportioned to regions and zones using criteria K_2.

Other external explicit indirect costs are the expenditure by the Ministry of Public Health in providing malaria surveillance through village health centres and hospitals. Study is made of the direct internal cost of malaria inpatients and outpatients treated in hospitals. In determining the cost of surveillance through village health centres, explicit indirect expenditure by the Ministry of Public Health has not been included.

Expenditure by patients and relatives

Explicit direct costs are incurred by patients in the self-prescription of drugs, in expenditure on seeking care and travelling cost. Relatives in attendance on patients also incur the explicit indirect cost of travelling.

Time cost

Implicit direct costs are time cost incurred by patients through absence from work before, during and after seeking care, by malaria village volunteers when engaged in work for the malaria service and by people when interacting with ACD workers. Implicit indirect costs are time costs incurred by relatives in attendance on patients.

Time costs could be based on minimum wage rate, average local wage rate or average income of patients. (Income may be expected to vary seasonally). Since patients´ reporting of their income is not reliable, minimum wage rate and average local wage rate are used to determine the time cost of relevant people between the ages of 15 years to 60 years.

Expenditure and time cost of patients and relatives are expressed in terms of mean, median and mode. The most appropriate measure of central tendency is used in determining each external explicit and implicit cost.

2.2 Performance criteria

The primary objective of the research was to determine HOW the cost and performance of malaria surveillance and monitoring measures could be undertaken. The first step was to analyze surveillance and monitoring to identify the main activities (blood slide collection, microscopic examination, treatment, case investigation, follow up and monitoring) and the operational services undertaking surveillance and monitoring (ACD, malaria clinic, malaria village volunteer, village health centres, hospital, etc.).

Five types of criteria are used within the study to express the performance of surveillance activities and operational services: cost (see section 2.1); effectiveness (%) time (days); relative contribution (%); and efficiency (expressed as cost/unit). Performance criteria for surveillance activities, for surveillance undertaken by operational services and for occasional surveillance activities are described in Tables 6, 7, and 8 respectively.

Effectiveness (%)

Percentage effectiveness is a measure of the extent to which a target is met, i.e. the percentage effectiveness of a microscopist in meeting a daily target of 70 slides examined. Comparison of the percentage effectiveness of processes is possible under two conditions: the same process in different situations and alternative processes in the same situation.

Time (days)

Performance of some activities is best expressed as the time taken to complete the activity, e.g. time taken to collect a blood slide and complete microscopic examination. Performance may be expressed as the average time (arithmetic mean and standard deviation); the cumulative percentage completed in successive days (percentage completion curve) or, where an elapsed time can be set as a target, expressed as percentage effectiveness in the specified time. Time taken to complete processes may be compared whether the process are complementary or alternative.

Relative contribution (%)

Percentage relative contribution expresses the contribution made by each operational service to surveillance within an area. Percentage effectiveness of each service is not a valid measure of performance since the operational services are complementary.

Efficiency (cost unit)

Efficiency is a measure of the relationship between the outcome from a process and the input. Efficiency may be expressed as percentage efficiency (where input and outcome are in the same units); as cost benefit (where the benefits or outcomes are expressed in money terms and related to input costs); and as input/output relationship (where units are disparate).

CRITERIA USED TO MEASURE THE PERFORMANCE OF SURVEILLANCE ACTIVITIES

ACTIVITY	PERFORMANCE CRITERIA	TYPE OF CRITERIA	SOURCE OF DATA
1. HOUSE VISITING	1.1 Percentage effectiveness in house visiting $= \frac{\text{Number of houses visited}}{\text{Number of target houses}} \times 100$	Effectiveness %	Secondary Source MS1 forms
	1.2 Percentage effectiveness in understanding interviews $= \frac{\text{Number of houses where interviews were conducted}}{\text{Number of target houses (houses to be visited)}} \times 100$	Effectiveness %	Secondary Source MS1 forms
2. TAKING BLOOD SLIDES	2.1 Percentage effectiveness of taking blood slides (ACD) $= \frac{\text{Number of blood slides taken}}{\text{Number of slides which should be taken}} \times 100$	Effectiveness %	Primary survey - follow-up of house visitors
3. BLOOD SLIDE EXAMINATION	3.1 Time between taking a blood sample and completing microscopic examination Expressed as cumulative percentage positive cases completed in each successive day after taking a blood slide, arithmetic mean of time, and standard deviation	Time	Secondary source - MS8 forms analysed for each operational service and occasional activity
	3.2 Percentage effectiveness in completing examination of blood slides $= \frac{\text{Number of blood slides examined in a period of time}}{\text{Target number of blood slides}}$	Effectiveness %	Secondary source - MS6 forms
	3.3 Time between taking a blood sample and reporting results to zone chief. Expressed as cumulative percentage positive cases reported to zone chief each successive day after taking a blood slide, arithmetic mean of time, and standard deviation	Time	Secondary source - MS8 forms analysed for each operational services and occasional activity

TABLE 6

TABLE 6 (cont'd)

OPERATIONAL SERVICE	PERFORMANCE CRITERIA	TYPE OF CRITERIA	SOURCE OF DATA
	3.3 Cost/inpatient $= \frac{\text{Total cost of treating malaria inpatients}}{\text{Number of malaria inpatients}}$	Cost/unit	Secondary survey of a hospital
	3.4 Cost/outpatients $= \frac{\text{Total cost of treating malaria outpatients}}{\text{Number of malaria outpatients}}$	Cost/unit	Secondary survey of a hospital
4. ALL OPERATIONAL SERVICES	4.1 Relative effectiveness of case detection $= \frac{\text{Rate of cases detected}}{\text{Rate of cases which existed}} \times 100$	Effectiveness	Primary survey undertaken to determine rate of cases existing and rate of cases detected in a four week period

TABLE 7

CRITERIA USED TO MEASURE THE PERFORMANCE OF SURVEILLANCE BY OPERATIONAL SERVICES

OPERATIONAL SERVICE	PERFORMANCE CRITERIA	TYPE OF CRITERIA	SOURCE OF DATA
1.. ACD	1.1 Case detection = Number of cases detected by operational service / Total cases detected in the zone	Relative Contribution %	Secondary source - MS5 and MS7 forms
	1.2 Cost/positive case = Total cost of diagnosis and treatment (each service) / Number of +ve cases detected by each service	Cost/Unit	Analysis of costs from budgets and MS5 and MS7 forms
	1.3 Cost/blood slide = Total cost of diagnosis and treatment (each service) / Total number of blood slides through each service	Cost/unit	Analysis of costs from budgets and secondary source MS1 and MS3 forms
2. MALARIA CLINICS	2.1 Performance of patients Time between having fever and seeking care at malaria clinic. Expressed as cumulative percentage of fever patients seeking care in each successive day, arithmetic mean of time and standard deviation	Time	Primary survey of 5,000 patients at malaria clinics
3. HOSPITAL	3.1 Percentage effectiveness in case detection = (Cases detected through medical diagnosis / Cases detected through blood slide screening) x 100	Effectiveness %	A primary survey of all patients visiting a hospital during a 2 month period (July/August '82)
	3.2 Case detection by Hospital = (Number of cases detected by local hospitals / Number of cases detected in the zone) x 100	Relative Contribution %	Secondary source MS5 and MS7 forms

TABLE 7 (cont'd)

ACTIVITY	PERFORMANCE CRITERIA	TYPE OF CRITERIA	SOURCE OF DATA
	3.4 Percentage effectiveness of identification $= \frac{\text{Number of slides found to be positive}}{\text{Number of positive (checked) slides}} \times 100$	Effectiveness %	Secondary source - MS5 and MS7 forms
4. TREATMENT	4.1 Time between taking a blood sample and giving radical treatment Expressed as a cumulative percentage of positive cases given radical treatment each day after taking blood slides, arithmetic mean of time, and standard deviation	Time	Secondary source - MS8 forms analysed for each operational service and occasion
	4.2 Percentage effectiveness in providing radical treatment $= \frac{\text{Number of cases provided with radical treatment within target time}}{\text{Number of cases which should be provided with radical treatment in target time}}$	Effectiveness %	Secondary source - MS8 forms
5. CASE INVEST-IGATION	5.1 Percentage effectiveness of case investigation $= \frac{\text{Number of cases investigated in a year}}{\text{Number of positive cases detected in the year}}$	Effectiveness %	Secondary source - MS6 forms
6. FOLLOW UP OF CASES	6.1 Percentage effectiveness in follow up to schedule $= \frac{\text{Number of cases followed up according to schedule}}{\text{Number of cases to be followed up according to schedule}}$	Effectiveness %	Secondary source - MS8 forms
7. MONITORING	7.1 Percentage of entries in each column $= \frac{\text{Number of completed items}}{\text{Number of items to be completed}}$	Effectiveness %	All MS forms

TABLE 8

CRITERIA USED TO MEASURE THE PERFORMANCE
OF OCCASIONAL ACTIVITIES PROVIDED BY ZONE TEAMS

OCCASIONAL ACTIVITIES	PERFORMANCE CRITERIA	TYPE OF CRITERIA	SOURCE OF DATA
MOBILE CLINIC			
CASE INVESTIGATION			
FOLLOW UP			
MASS BLOOD SURVEY			
SPECIAL SURVEY			
	1. Case detection $= \frac{\text{Number of cases detected by each occasional activity}}{\text{Total cases detected in the zone}}$	Relative Contribution %	Secondary sources MS5 and MS7
	2. Cost/case $= \frac{\text{Total cost of each occasional activity}}{\text{Number of +ve cases detected by each occasional activity}}$	Cost/Unit	Analysis of costs from budgets and MS8 forms
	3. Cost/investigation $= \frac{\text{Total cost of each occasional activity}}{\text{Number of patients investigated by each occasional activity}}$	Cost/Unit	Analysis of costs from budget and MS8 forms
	4. Time taken between taking a blood slide and completing microscopic examination (See Table)	Time	
	5. Time taken between taking a blood slide and reporting results to zone chief (See Table)		
	6. Time taken between a blood slide and providing radical treatment (See Table)	Time	

Cost per unit, a measure of input/output relationship, is used extensively in this study, e.g. cost/blood slide and cost/positive case. Cost/unit for the same activity or process in different areas may be compared. Comparisons may suggest where reduction in costs should be sought or improvement in operations could be considered.

2.3 Gathering data

Sections 2.1 and 2.2 were concerned with describing how the costs and performance of malaria surveillance activities and operational services might be measured. Questions examined were what could and should be measured and in what circumstances. One major issue remains. How to gather data to be used in an analysis.

If the methods of cost and performance analysis developed are to be used by malaria managers, methods for gathering data and the outcomes from the analysis of data must be relevant and practical. In terms of gathering data, that means abstracting data from readily available secondary sources, and conducting primary surveys with the budgets and manpower already available.

Three topics are presented in this section:

i) Evolution of procedures for gathering data.
ii) A review of twelve primary surveys.
iii) Summary of sources of data.

(i) Evolution of procedures for gathering data

To determine how best to measure the costs of performance of the malaria surveillance and monitoring system, data were drawn from secondary and primary sources; secondary sources, such as budgets and monitoring forms and primary surveys in areas, such as performance of house visitors, explicit costs of patients, etc. In line with the primary aim of the project local malaria service personnel were trained to conduct the primary surveys and collected most of the data from secondary sources.

It has to be acknowledged that a considerable time was spent by malaria staff in Zones 3 and 7 on training and undertaking primary surveys; 200 man days of work for one survey. Experience has shown that some surveys can be simplified, others omitted as inappropriate. There has to be a trade-off between time spent in gathering management data and the time and resources expended. Subsequent experience with a third zone, Zone 6 suggests that the work load for modified surveys is acceptable.

Procedure for gathering data evolved over nine stages:

i) Initial discussion with malaria division staff at Divisional and Regional Headquarters and at two zones.

ii) Research team gather data from secondary sources with the assistance of Malaria Division staff (Regional Headquarters and Zones 3 and 7 in Region 1). Every record and form used in the system in 1980-1981 was examined.

iii) Discussion of concepts, ideas and proposals with Malaria Division staff.

iv) Identification of data required, development of questionnaires and data forms by research team.

v) Collection of data by Malaria Division staff (Zones 3 and 7 in Region 1) with guidance and supervision by the research team. Also collection of some data through all malaria clinics in Region 1.

vi) Analysis of results by the research team and discussion of findings with staff of the Malaria Division. Issues examined included validity and reliability of data, comparing data from stages (ii) and (v), difficulties with procedures and measuring instruments and clarification of concepts and ideas.

vii) Refinement of measuring instruments and procedures by the research team.

viii) Collection of data by Malaria Division staff in Zone 6, Region 1, using refined measuring instruments and recommended procedures. An initial briefing was given but supervision was not provided.

ix) Discussion and review of procedures and measuring instruments with staff of Zone 6.

The evolution described allowed for four outcomes; education of the research team (understanding the system, developing concepts and identification of data required); educational development of staff in the Malaria Division in research methodology and concepts particularly at Zone and Regional level; iterative development of measuring instruments and procedures; and field testing of instruments and procedures.

(ii) Primary surveys and survey forms

Primary surveys were undertaken in the malaria services and hospital service to gather data on costs, criteria for apportionment of costs and performance. Expenditure on fixed assets was not included in the analysis of costs (see 2.1) because records of such expenditure are incomplete and no depreciation of fixed assets is recognized in the accounting system. However, three surveys were made to explore the feasibility of introducing a more comprehensive accounting system. Primary surveys were made of land and buildings in Region 1 Headquarters and Zones 3, 6, and 7 in Region 1; price, age and condition of microscopes; and usable life of microscope slides.

(iii) Sources of data

Data were gathered for three purposes: to determine costs, direct and indirect; to estimate criteria for apportioning expenditure; and to assess performance.

Primary surveys for the malaria services are listed in Table 9. Although general purposes for gathering data from the surveys are shown in Table 9, details of the type of information obtained are not shown in this section. Results of all surveys are presented in Section 3 and 4. Sources of data in relation to measurement of the performance of surveillance activities and operational services are shown in Tables 6 and 7.

2.4 Guidance on the Measurement of Costs and Performance

A comprehensive handbook containing guidance on procedures which might be used for investigating the costs and performance of malaria surveillance and monitoring measures in Thailand will be prepared after this report has been reviewed by staff of the WHO and Malaria Division in Thailand.

This section is written for researchers who may wish to explore the costs and performance of other diseases control programmes in Thailand and other countries.

Firstly, general guidance on studies of the cost and performance of disease control programmes. Secondly, guidance on using the procedures and measuring instruments, described in this report in other countries.

2.4.1 Guidance on studies of the cost and performance of disease control programmes

Outsiders initiating cost and performance studies of any disease control programme face immense difficulties in really understanding the system and procedures and gathering information to measure what occurs in practice. Both tasks are impossible without the agreement and tangible support of senior staff within the control programme.

In this particular study the commitment of the Malaria Division was secured before the proposal was even drafted. But in spite of the enthusiasm and support of the staff of the Malaria Service the researchers acknowledge that they still have a relatively superficial understanding of the complexities of the system of surveillance. This has meant that the analysis may not fully reflect the objectives and realities of malaria disease managers.

Full, but nonetheless cautious support is likely only if the results of the study will be beneficial to the disease control managers and facilitate better use of resources.

It is important therefore that researchers focus their efforts on providing instruments and procedures which the disease control managers can use personally in monitoring the costs and performance of their own system. The research is an aid to those within the system and not an outside evaluative study of the system.

Any study of the costs and performance of a disease control programme is, by its very nature, threatening to those managing the programme.

Staff in the control programme should be consulted on how best to proceed and not simply be informed of the progress made. Health economists may be specialists in the analysis of costs and performance of health care processes. But disease control managers are the specialists in the field being studied. The required productive exchange of ideas cannot be achieved unless both parties are willing to share their ignorance and doubts as well as their knowledge and beliefs.

TABLE 9

MALARIA SERVICES (PRIMARY SOURCE)
SURVEYS TO ASSESS COST AND PERFORMANCE

Purpose; to assess

Cost - C
Apportionment criteria - A
Performance - P

1.	Land and building of malaria region 1 and zones 3, 6 and 7	C
2.	Usable life of blood slides	C
3.	Type, age and condition of microscopes in region 1 and zones 3, 6 and 7	C
4.	Allocation of staff time to activities	A
5.	Time cost of malaria village volunteers	C
6.	Work load of malaria staff in areas in different phases of the control programme	A
7.	Travelling cost and time cost of malaria patients: Number of days before seeking care	C,P
8.	Time cost of households being visited during ACD	C
9.	Assessment of the performance of house visitors	P
10.	Effectiveness of surveillance	
	- Rate of cases existing and cases detected within an area	P
	- Effectiveness of radical treatment	P
	- Drug consumption of patients	P
11.	Point prevalance of cases existing in an area	P
12.	Detection rate of malaria in non fever patients	P

Interaction with disease control staff requires the presentation of results and ideas in a constructive fashion with due regard to the sensitivities of the people concerned. Disease control staff will also require training and encouragement. Research studies are slow and contact with disease control staff often occurs only when they are required to contribute to the study. To secure commitment, and hence more reliable results, staff must be convinced of the need for accuracy and the waste of their own time if the results of surveys, which they conduct, are not reliable.

Comments made concerning cooperation of staff in a disease control programme are equally relevant to personnel providing essential information from primary and secondary sources, patients, medical personnel, field workers and ministries. Cultural norms of protocol, procedure and politeness can be more significant in securing a satisfactory outcome to a cost and performance study than the concepts and methodology used.

2.4.2 Guidance in using measuring instruments and procedures in other countries

It would be both encouraging and satisfying if the measuring instruments and procedures developed in this study could be directly applied to the analysis of the costs and performance of malaria surveillance and monitoring measures in other countries. In practice, replication will be most unlikely because of different budgeting and accounting systems, because of different views on costs, and because organizations responsible for surveillance will probably have a different structure. But some guidance can be offered on the issues which will require special attention and local study.

1. Evaluation of concepts, measuring instruments and procedures (Section 2.1, 2.2 and 2.3) should be well documented to allow examination of any changes made as the study proceeds.

2. Instructions on the conduct of surveys, primary and secondary, should be written, and pilot studies undertaken before major surveys are launched. Field personnel must be briefed and, if appropriate, trained in the procedures to be followed.

3. Budget systems in each country will differ. The time consuming process of apportioning expenditure under budget headings described in 2.1.3 will be unnecessary where the Malaria Service uses programme budgeting, where programme budgets are submitted in terms of expenditure on each activity, or where the accounting system records costs of activities.

4. If job descriptions of personnel clearly identify the proportion of time likely to be given to each task, primary surveys or work patterns will not be required.

5. Measurement of performance could be simplified if targets were clearly stated and outcomes were systematically recorded. Measurement of performance could then be built into the system without special surveys.

6. Surveillance and monitoring procedures may be quite different in other countries. Early identification of "the system's" particular forms of operational services and activities are essential.

7. Apportionment of costs at Division, Region and Zone and Sub Zone described in the report may be unique to Thailand. some countries have provincial responsibility for surveillance rather than the national Thai pattern. The organizational structure will dictate the system to be followed in apportionment.

8. Perspective on costs may be different in each country. Terms used in this report to describe aspects of costs could be generally applicable. But what is included in the total cost of a process or activity will depend upon the perspectives of the analyst and staff of the malaria service.

9. If efforts are made to compare the costs of surveillance and monitoring of several countries attention will have to be given to the shadow price of imported items such as drugs and chemicals.

10. Where there is extensive integration, involvement of the medical services and Malaria Service in antiparasite activities, costing of activities will be more difficult.

3. ANALYSIS OF COST DATA

The system for apportioning expenditure of the Malaria Division to operational units and operational services is outlined in Section 2.1.3. A similar system for apportioning hospital expenditure to malaria inpatients and outpatients is outlined in Section 2.1.4.

In this section, the cost of antiparasite activities in Zones 3 and 7 in Region 1 are examined. Costs are based largely on the apportionment of expenditure under budget headings to operational units, operational services and antivector activities. In general external costs and therefore the total cost to the community are not considered. But a study is reported on the total cost (internal and external) of patients attending malaria clinics.

Criteria selected for the apportionment of malaria division expenditure are presented in Table 5. Criteria selected for the apportionment of hospital expenditure are presented in Table 10.

Analysis is also made in this section of the effect of external costs on the overall cost/case of operational services.

The costs presented of Divisional Headquarters, Region 1 Headquarters and Zones 3 and 7 in Region 1 are examples to illustrate the outcome from using the system for the apportionment of budget expenditure. Some issues raised by the nature of the costs are examined in this section. But final judgement about any implications of these particular costs must rest with senior staff in the Malaria Service and Hospital Service.

3.1 Cost of Operational Units at Divisional Headquarters, Regional Headquarters and Zones 3 and 7

Division vs Regional Headquarters

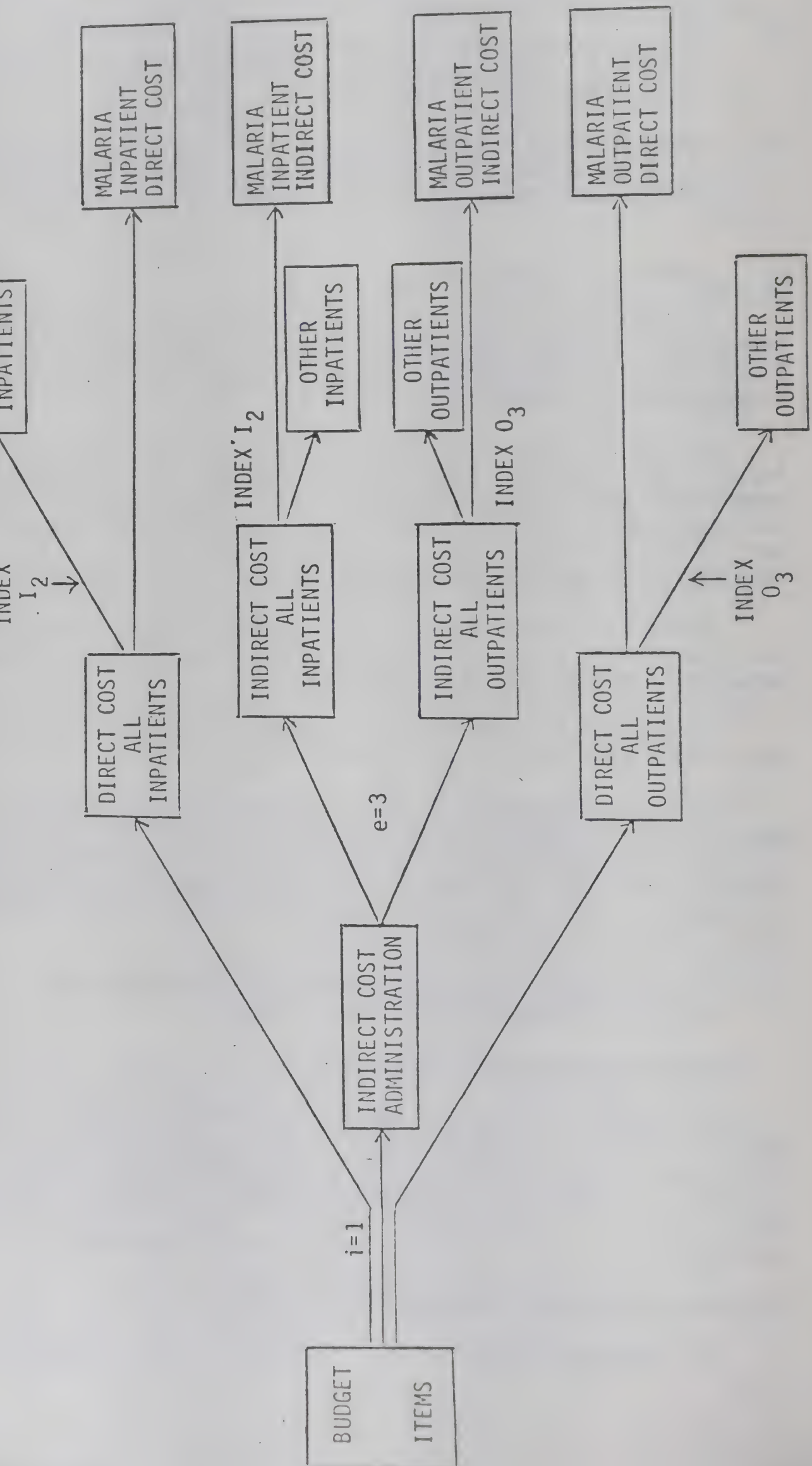
Divisional and Region 1 Headquarters show a similar pattern of costs; approximately 40% to administration, 2-3% on applied research and 10% for each of the remaining operational units. given their different functions it is perhaps surprising that Divisional and Region 1 Headquarters should show a similar pattern of expenditure. Region 1 could be unique in this pattern of expenditure or it may be common to all Regional Headquarters.

Division and Regional Headquarters vs Zones

The distribution of costs to operational units at zones is significantly

TABLE 10

SYSTEM FOR APPORTIONING HOSPITAL EXPENDITURE TO MALARIA INPATIENTS AND OUTPATIENTS



different to that at Divisional and Region 1 Headquarters. Zones spend a smaller proportion of their budgets on administration, health education, entomology and laboratory, a higher proportion on epidemiology, insecticides and spraying and approximately 20% on treatment.

The lower proportion of budget to administration and higher proportion to treatment and spraying and insecticides by each zone is to be expected because of the nature of their field operations. As a result zones spend 80-90% of their budgets on antiparasite and antivector measures compared with 40% at Division and Regional Headquarters.

ZØnevsZØne

The nature of Zones 3 and 7 has been described in section 1.3. and Table 3 Areas (sq. km) in total and in each phase are very similar with approximately 50% in control phase in Zone 3 and 60% in control phase in Zone 7. In terms of population Zone 3 has twice the population of Zone 7, 80% of the population in partial integration (50% in Zone 7), approximately 9% in consolidation phase (2% in Zone 7) and approximately 11% in control phase (48% in Zone 7).

As a result of the large population in control phase (240,000 in Zone 7, 136,000 in Zone 3) in roughly the same geographical area Zone 7 spends almost twice as much as Zone 3 on insecticide and spraying. Expenditure on antiparasite measures are roughly the same in the two zones with one exception. Laboratory costs in Zone 3 are approximately one-third of the costs in Zone 7, with half the number of blood slides examined.

One factor contributing to this lower cost could be the absence of a central malaria clinic associated with Zone 3 Headquarters. The main laboratory at Regional Headquarters provides a laboratory service for Zone 3. A feature which is difficult to explain is the high cost of administration in Zone 3; double the cost of Zone 7. This figure may be partly affected by administration of MVV´s approximately 2,080 in Zone 3 and 980 in Zone 7.

3.2 Cost of Antiparasite Measures at Division, Region and Zone levels

Apportionment through stages 1-4 of the micro cost model yields direct and indirect costs of antiparasite measures. Costs may be expressed at Zone, Region and Division levels. Figures for Zones 3 and 7 at Zone and Division level are presented in Table 11.

Zone level

Several similarities and differences are apparent. total cost of antiparasite measures (total direct and indirect costs) are effectively the same even though the zones with similar areas (km^2) have markedly different populations, terrain and incidence of malaria. Zone 3 examined 70,963 blood slides with approximately 5,000 positive cases in 1980. In the same year Zone 7 tested 140 912 blood slides and found approximately 12,000 positive cases.

Treatment and epidemiology (monitoring) in both zones account for 72% of the total direct and indirect cost of surveillance, approximately 36% on treatment and 36% on epidemiology. This is probably fortuitous rather than a general characteristic of all zones since it will be affected by the mix of surveillance services, number of patients and positive cases.

TABLE 11

DIRECT AND INDIRECT COST OF SURVEILLANCE
FOR ZONES 3 AND 7 AT DIVISIONAL LEVEL

OPERATIONAL UNITS — COST X 10^3 BAHT	ZONE 3				ZONE 7			
	TOTAL COST	PROPORTION			TOTAL COST	PROPORTION		
		FROM ZONE	FROM REGION	FROM DIVISION		FROM ZONE	FROM REGION	FROM DIVISION
DIRECT COST								
LABORATORY	178	99	56	23	438	364	52	22
%	(5.2)	55.9	31.5	13.0	(12.6)	83.2	11.9	4.9
EPIDEMIOLOGY	1,154	1,109	28	16	1,168	1,126	26	15
%	(34.0)	96.1	2.5	1.4	(33.6)	96.4	2.3	1.3
TREATMENT	1,050	1,050	-	-	1,146	1,146		
	(31.0)	100			(33.0)	100		
TOTAL DIRECT	2,382	2,382	84	39	2,752	2,638	78	37
%	(70.2)	94.8	3.6	1.6	(79.2)	95.8	2.8	1.4
INDIRECT COST								
ADMINISTRATION	859	688	111	59	603	390	139	74
%	(25.3)	80.2	12.9	6.9	(17.3)	64.7	22	12.3
HEALTH EDUCATION	143	98	28	18	111	53	35	23
%	(4.2)	68.1	19.3	12.6	(3.2)	48.2	31.3	20.5
APPLIED RES.	9	-	5	4	11	-	6	5
%	(0.3)	-	54.9	45.1	(0.3)	-	56.9	43.1
TOTAL INDIRECT	1,011	786	144	81	725	443	180	102
%	(29.8)	77.7	14.3	8.0	20.8	61.1	24.8	14.1
TOTAL COST	3,392	3,043	228	121	3,476	3,080	258	138
%	100	89.7	6.7	3.6	100	88.6	7.4	4.0

Major differences between the zones are the lower laboratory costs in Zone 3 (discussed earlier) and the high administrative costs of Zone 3. High administrative costs in Zone 3 are difficult to explain given the lower number of blood slides and cases in Zone 3.

Division level

The principle feature at division level, not evident at zone level is the proportion of total costs from Zone, Region and Division. Both zones show similar figures approximately 7% from the Region and approximately 4% from the Division.

3.3. Direct and Indirect Costs of Operational Services and Occasional Activities at Zone Level

The total cost of surveillance at zone level is the sum of the direct cost (laboratory, treatment, epidemiology and monitoring) and indirect costs (administration and health education). The latter is a proportion of the total administrative and health education cost of the zone apportioned to antiparasite measures.

Components of these direct and indirect costs can be apportioned to operational services and occasional activities for each zone (Tables 12 and 13 respectively).

Blood slides examined in hospitals are omitted from the apportionment since hospitals undertake their own laboratory analysis. But hospital cases identified as positive are monitored by the malaria service. A proportion of total costs of epidemiology is therefore apportioned to the hospital service in relation to the number of cases detected.

Many factors affect the cost of each operational service; the number of blood slides, number of positive cases and the labour cost of epidemiology and treatment. Comparison of costs among services within a zone and between the same services in two zones is therefore difficult. But some features are clear. Approximately 70-80% of total cost is incurred through three services; ACD, MC and MVV. The lower figure of 70% in Zone 3 arises because a large number of cases in the zone are identified and treated by the hospital service.

A second feature is the distinctive distribution of costs to malaria clinics. A low laboratory and treatment cost compared to other services but high epidemiology or monitoring cost. This is presumably because malaria clinics require little labour time to deliver treatment but demand high expenditure in monitoring the large number of cases examined. Cost of monitoring is based upon analysis of time spent on monitoring. It is assumed, in determining costs, but found to be incorrect in study of performance that all monitoring activities are completed as required by procedures.

What are the differences, if any between the Zones? There are two features of note: the low ratio of direct to indirect costs of ACD and MVV in Zone 3 and the high cost of epidemiology for the hospital service. The latter arises because of the large number of malaria cases identified by the hospital service in Zone 3. But the low ratio of direct to indirect cost is more difficult to explain. The high cost of administration in Zone 3 was identified earlier (Table 11). It would seem that the services making most demand on zone administration are ACD and MVV.

TABLE 12

DIRECT AND INDIRECT COST OF OPERATIONAL SERVICES AT ZONE LEVEL : ZONE 3
(Cost to nearest 1,000 Baht)

COST ITEMS \ OPERATIONAL SERVICES	TOTAL	ACD	MC	MW	HOSP	VHC	CI	FU	MBS	SS	MOBILE CLINIC
1. DIRECT COST											
1.1 Lab & Treatment	1,148	401	54	538	-	126	12	10	2	1	2
%	(37.7)										
Laboratory	99	30	24	27	-	11	5	1	<.5	<.5	1
	(3.2)										
Treatment	1,050	372	30	511	-	115	7	9	2	1	1
	(34.5)										
1.2 Monitoring Epidemiology	1,109	18	497	65	260	24	225	11	3	2	3
	(36.4)										
TOTAL DIRECT COST	2,257	419	551	604	260	151	237	21	6	4	5
	(74.1)	18.6	24.4	26.8	11.5	6.7	10.5	.9	.26	.18	.2
2. INDIRECT COST											
Administration	688	334	67	277	3	50	3	3	1	1	-
	(22.6)										
Health Education	98	41	10	35	1	9	1	4	<.5	<.5	-
	(3.2)										
Total Indirect Cost	786	375	76	263	3	59	4	3	2	1	-
	(25.8)	47.7	9.7	33.5	.4	7.5	.5	.4	.2	.1	-
TOTAL DIRECT AND INDIRECT COST	2,043	794	627	866	263	210	242	24	7	4	5
%	100	26.1	20.6	28.4	8.6	6.9	8.0	0.8	0.2	0.1	0.2

TABLE 13

DIRECT AND INDIRECT COST OF OPERATIONAL SERVICES AT ZONE LEVEL : ZONE 7
(Cost to nearest 1,000 Baht)

COST ITEMS \ OPERATIONAL SERVICES	TOTAL	ACD	MC	MW	HOSP	VHC	CI	FU	MBS	SS	MOBILE CLINIC
1. DIRECT COST											
1.1 Lab & Treatment	1,510	560	113	669		74	38	6	30	10	10
%	(49.0)										
Laboratory	364	173	71	52		18	22	1	12	7	8
	(11.8)										
Treatment	1,146	387	41	617		56	16	5	18	3	2
	(37.2)										
1.2 Monitoring Epidemiology	1,126	160	543	139	44	45	141	8	23	8	17
TOTAL DIRECT COST	2,636	720	655	808	44	119	179	14	53	18	27
	(85.5)	27.3	24.8	30.7	1.7	4.5	6.8	.5	2.0	.7	1.0
2. INDIRECT COST											
Administration	390	188	53	131	1	10	4	-	2	-	<.4
	(12.7)										
Health Education	54	27	9	15	<.2	1	<.4	-	<.3	-	-
	(1.8)										
TOTAL INDIRECT COSTS	433	216	62	146	1	11	4	-	-	-	<.4
	(14.5)	48.8	14.0	33.0	.2	2.5	1.0				
TOTAL DIRECT AND INDIIRECT COST	3,080	936	717	954	45	130	183	14	55	18	27
%	100	30.4	23.3	31.0	1.4	4.2	5.9	0.4	1.8	0.6	0.9

The effect of costs can only really be assessed in relation to the performance of each service and the contribution each service makes to the community.

The internal cost/patient, cost/positive case as measures of performance and the relationship between internal and external cost/case and cost/patient is examined in Section 4.7.

3.4 External Costs

Two external costs are considered in this study; external direct and indirect costs incurred by malaria patients and relatives in seeking medical care, and external direct costs arising from support provided by international aid organizations.

3.4.1 Costs incurred by malaria patients attending malaria clinics

There are two components to the overall cost of each malaria case; internal cost and external cost. Internal cost is the cost/case incurred by each operational service. The nature of such costs is presented in Section 4.7. External costs are the costs incurred by patients and relatives attending with a patient.

External direct explicit costs are expenditure by each patient in travelling to receive care and in self-prescribed drugs. External direct implicit costs is the time cost of the patient, (working time lost) when travelling to receive care or due to the effects of the malaria infection. Relatives may also incur external costs when attending a clinic with a patient indirect (explicit and implicit).

The malaria service may be largely concerned with internal costs/case. But the community particularly the Ministry of Public Health should be concerned with the overall cost/case and the magnitude and ratio of internal to external costs.

All positive cases and relatives attending malaria clinics in Region 1 over a 1 month period were questioned to determine external direct and indirect costs (n = 3,431). Positive cases were selected as providing a large enough sample and being a representative sample of the population seeking diagnosis at malaria clinics. Time cost is based upon the minimum wage rate of 55 Baht for a 6 hour day.

A surprising feature was that approximately 30% of the sample reported incurring no expenditure. Since the relationship of cost/case to number of cases is not a normal distribution the median rather than mean is used in the analysis as a measure of the central tendency of cost for the sample.

For patients attending malaria clinics external direct costs are approximately 710 Baht/case; approximately 50 Baht/case direct explicit cost and approximately 660 Baht/case direct implicit cost. External indirect costs incurred by relatives are approximately 105 Baht/case; 28 Baht explicit cost and 77 Baht implicit cost. As shown in section 4.8 such costs are significant in relation to the internal cost/patient.

3.4.2 External costs associated with other operational services

The total cost of other operational services will also be affected by the magnitude of external costs. An in-depth study has not been made to determine external costs. However some estimate may be made in relation to the external costs of patients attending clinics.

ACD

External costs are the time cost of persons responding to enquiries by house visitors and time cost of patients due to absence from work. The opportunity costs of persons responding to questions by house visitors may be assumed to be zero since the person/s were not specifically waiting for the arrival of the house visitor. The time cost of patients due to absence from work is difficult to estimate. Since patients must await a visit by a house visitor and then wait for treatment the time cost could be greater than that incurred by patients attending malaria clinics. This suggests that the external cost/case will be equal to or in excess of the 710 Baht/case for patients attending malaria clinics.

MVV

Malaria village volunteers provide more outreach to patients than malaria clinics. Travelling cost and time cost of patients seeking care will therefore be small in relation to costs in attending malaria clinics. Time cost due to absence from work is difficult to estimate. Assuming time lost before seeking care is zero (convenient location of MVV)other factors are comparable to patients attending malaria clinics. This suggests an external cost of approximately 925 Baht/case; 30 Baht drugs, 495 Baht time cost between giving a blood sample and receiving radical treatment (approximately 9 days x 55) and 400 Baht time away from work after receiving radical treatment.

The time cost of MVV's an additional external cost, is very small; 1 Baht/case given approximately 6-7 minutes attendance time/case and assuming cost/hour at the minimum wage rate.

VHC

Patients attending village health centres may incur similar direct explicit costs in travelling to patients attending malaria clinics. Time costs due to absence from work arising from malaria are likely to be greater than for patients attending malaria clinics since the time taken to diagnose a case and provide treatment is much longer (approximately 8-13 days). The external cost is therefore likely to be approximately 1,260 (710 Baht/Case + (10 x 55)).

These external costs are very rough estimates. However it is clear that external costs are a major part of the total cost/case (see section 4.7) and further detailed study is required before valid comparison of total costs can be made.

3.4.3 Support from international organizations

Support provided by international organizations can also be considered as an external cost since the expenditure is external to the budgets provided to the division, regions and zones. The World Health Organization and USAID are the main sources of such external support.

It was initially intended that support from external organizations would be included in the analysis of costs (Progress reports No. 1 and 2). However, gathering data for a retrospective study has proved to be very difficult since detailed records are not readily available. External costs could be included in total costs analysis if more systematic recording was made of the nature of support from international organizations and distribution to Regions and Zones.

International organizations provide support in physical and financial terms. Physical terms include consultants and experts; volunteers; microscopes, chemical supplies and drugs. Finance is usually allocated to particular research projects. Total aid in 1980-81 fiscal year is reported to be approximately 52 x 10^6 Baht. This is of the same order of magnitude as the Malaria Division Headquarters budget for 1980-81, 62.7 x 10^6 Baht with a total budget for the Malaria Division of 173.3 x 10^6 Baht.

External support is clearly a significant factor in the total expenditure on the Anti-Malaria Programme.

The way the aid is spent will affect total costs of operational units and operational services. But no satisfactory system has been developed for retrospective apportioning of expenditure. If costs are ascertained when resources are provided, costs could be assigned to appropriate services. Microscopes, chemical supplies and drugs can be costed to the user services. Costs of consultants are more difficult to assign to a service.

Direct financial support from international organizations is also provided for special programmes and activities such as construction of a training centre, training of staff and research projects.

Although a training centre might be located in Region 1, expenditure on the building is not a cost for Region 1 where training is provided to other regions. But since expenditure on fixed assets is not included in this study, this type of financial support would have to be omitted from any cost analysis.

Expenditure in support of training personnel is more difficult to assign to an operational unit or service except where the training is directed to a particular service i.e. training of microscopists. A retrospective study of 1980-81 yielded little reliable information about programmes, participants and expenditure.

Although systematic recording of how funds are spent on training would be helpful, one problem remains. How to apportion expenditure on training in relation to the return on investment; return over several years and return to activities at division, region and zone.

Assignment of funds in support of research is much simpler. Funds to support research prospects may be viewed as an external direct cost of research operational units.

3.5 Validity, Reliability, Feasibility and Value of Costing Procedures

Although the idea of apportioning costs may seem impractical, the cost model and analysis of criteria is a means to decide how best to determine the cost of surveillance and not an analysis to be repeated. Once a set of criteria are selected (as in Table 5) and a system for systematic recording of data introduced, it will be a relatively simple procedure to cost each

service. Research effort was required on this occasion to investigate alternatives and decide how data might be best gathered and costs determined.

But how valid are the costs? Do the costs reflect actual expenditure? How reliable are the costs? If staff in Zones 3 and 7 were to gather data for themselves would they get very similar costs? Is it feasible for local staff to gather data to determine costs. And, in the final analysis, is the cost data of any value? Can the cost data help malaria managers to improve the efficiency of their operations and their decision making?

3.5.1 Validity

The validity of the internal costs derived by apportioning expenditure under budget headings can only be confirmed through a comprehensive cost accounting system. In the absence of such procedures, validity can be tested by reflecting on the procedures of apportionment and testing the outcome from the procedures against any known or expected direct costs.

Several factors suggest that the approach followed will yield a more valid result than any alternative. Firstly, expenditure is apportioned. This is a more valid costing than attempting to cost all man hours and use of materials retrospectively without reference total expenditure. Secondly, costs are kept separate at each stage so there is no compounding of errors. Thirdly, different criteria or sets of criteria are used, quite legitimately, at each stage. Errors in any one criteria should be small in relation to all other apportionments.

In terms of outcome two measurements suggest that apportionment is not incorrect. The range of costs on using a variety of criteria is often quite small. Errors in selecting an inappropriate criterion should therefore be small. In addition, the order of magnitude of costs such as the direct cost for malaria clinics is consistent with costs determined from known expenditure.

3.5.2 Reliability

The reliability of data on which apportionment is based, both in the malaria service and hospitals has not been tested. A handbook (Thai) advising on the procedures to be adopted for systematically gathering data concurrent with expenditure is nearing completion. If field tested in Zones 3 and 7 it could show if the order of magnitude is appropriate. But no tests can be made to determine the reliability of data gathered in 1982.

Undoubtedly errors have and will occur. Collation of time doctors and nurses spend with patients yields more hours than there are in a week. Diaries of work patterns are known from many studies to be inaccurate. Errors also occur in accounts of payments. Reliability must be viewed as a matter to be tested when a more systematic approach is followed.

3.5.3 Feasibility

The feasibility in determining costs can be examined at two stages: the feasibility in gathering data on which to base apportionment; and the computation and analysis of data.

A trial in Zone 6 has shown that it is possible for field personnel to gather data without the presence of researchers. Zone 6 personnel were able to gather all necessary data except for expenditure at Divisional Headquarters. Data was gathered retrospectively for 1981-82. It seems reasonable to expect that if a log was kept by personnel, systematic collection of data would be

easy and require little time. Computation of costs is not a difficult matter but is time consuming. Computation might be more conveniently undertaken if a micro computer was made available at Malaria Division Headquarters.

3.5.4 Value

The ultimate test of the costing analysis is its value to the Malaria Division. If cost data is produced for each zone, will it help malaria managers make more informed decisions, lead to an increase in efficiency and provide the Malaria Division with more supportable arguments for budgets? That is a matter which can only be decided by the Malaria Division and WHO.

What is apparent is that costs can be determined retrospectively by apportioning expenditure under budget headings. A more appropriate system of gathering data concurrent with expenditure is described in a handbook produced for the Malaria Division (in Thai).

4 ANALYSIS OF PERFORMANCE DATA

To make informed decisions about which malaria surveillance services and activities should be improved or changed it is necessary to measure performance. Changes in performance over a time period can then be analyzed and the performance of similar services or activities in different sectors, zones or regions compared.

Several measures of performance have long been used by the Malaria Division. Where accurate data are available, the overall performance of a region or zone may be judged by malaria mortality and morbidity rates. In Thailand, a more reliable measure of the effect of the control programme is probably the annual parasite incidence (API) and parasite rates among specific age groups. But the epidemiological significance of API and parasite rates depends upon a consistent and adequate system of case detection. Other measurements frequently quoted are the annual blood examination rate and slide positive rate. The former measures the effectiveness of surveillance; effectiveness in achieving a designated examination rate. The latter, while reflecting changes in the incidence of malaria among a population is also influenced by operational decisions.

Throughout the two years of the research, efforts were made to develop measures which could be used to evaluate the performance of services and activities - measures of outcome and measures of process.

The full list of possible performance measures are presented in Tables 6, 7 and 8. Some of these proposed measurements are of minor significance. Others have proved to be very difficult to measure reliably using available techniques.

In this section, results are presented of surveys made to assess the reliability, feasibility and value of several performance measures; overall performance of case detection; performance of operational services, performance of ACD, performance of laboratory services, performance in case investigation and follow up, performance of monitoring measures, efficiency of operational services (cost/case and cost/patient), efficiency of malaria clinics (cost/patient and cost/case), cost of malaria inpatients and outpatients in hospital and the performance of patients in seeking care.

4.1 Overall Performance of Case Detection

Performance of case detection could be best expressed as percentage effectiveness of case detection

$$= \frac{\text{Malaria cases detected within a population}}{\text{Malaria cases existing within a population}} \times 100$$

But malaria cases existing within a population cannot be measured retrospectively to compare with cases detected through surveillance.

It is also difficult to determine cases existing within a population over a period of time using available techniques. However, serological techniques which allow rapid detection of malaria antibodies in blood samples may provide a convenient technique in the near future.

As part of this research, two attempts were made to measure the effectiveness of case detection. The first attempt was an ill-conceived random survey of 50,000 persons. The special survey yielded a point prevalence of questionable validity and reliability which could not be compared with cases detected by operational services within a one month period.

In the second study the relative effectiveness of case detection was measured through study of the total population of 2,438 people in four villages.

$$\text{Relative effectiveness of case detection} = \frac{\text{Rate of case detected in a population} \times 100}{\text{Rate of cases existing in a population}}$$

Rate of cases existing

A 20% random sample of all houses within four villages was selected for study. All people (n = 547) living in these selected houses were examined every five days over a period of 36 days. A mass blood survey was made on the first day of the period. Temperatures were then taken of all people in the sample population every five days. Blood samples were taken from individuals with current fever from those with fever in the last five days, those arriving from elsewhere (to add to the MBS figures), and anyone with a positive slide at any point in the survey time. Finally, a mass blood survey was made on the 36th day Sixty three malaria cases were detected from the sample houses. A total of 84 cases were detected from the other houses on the final survey. If the rate of cases existing (detected incidence) is the number of cases detected in the period of time the rate of cases existing in the sample population of four villages

$$= \frac{63}{547} \times 100 = 11.5\%$$

Rate of cases detected

People living in the remaining 80% of houses within the four villages (n = 1,891) were left to seek diagnosis and treatment for malaria using normal services available to the villages. At the end of the study period (36 days) two surveys were conducted to determine the number of cases of malaria detected among the sample of 1,891 people.

Records were checked at local malaria clinics, malaria village volunteers and ACD to determine cases detected by these services. Thirty eight cases were detected out of a population of 1,891, a rate of case detection of 2.01%.

A second survey was made, using a questionnaire, to ask each of the 1,891 people if they had had malaria in the past 36 days (detected parasitologically and clinically). Eighty four people stated that they had had malaria. This yields a rate of case detection of 4.5%. However, this figure has to be treated with caution. Patient reporting of malaria is often quite unreliable and cannot be taken at face value. Patients forget when and where they were treated. Often people consider they have malaria and have been treated for it when in fact a blood slide was taken and presumptive dose of chloroquine administered.

Relative effectiveness of malaria case detection

These figures show two levels of relative effectiveness.

Relative effectiveness of case detection by all services (local and external) is

$$\frac{4.5}{11.5} \times 100 = 39.1\%$$

Relative effectiveness of cases detected by local malaria services is

$$\frac{2.01}{11.5} \times 100 = 17.5\%$$

If it is assumed that the incidence of malaria is the same in the population in the 20% of houses as in the 80% of houses in the four villages, five observations may be made.

i) The relative effectiveness of case detection in this population is low.

ii) Only 50% of cases detected were detected by local malaria services.

iii) The experiment was designated to explore how the overall effectiveness of case detection might be measured. It is not claimed that the sample is representative of the population in the area studied. But if the procedure has some value, the Malaria Division could consider applying the procedure to a large sample in other areas.

iv) The four villages selected for study were all within a control phase with a high incidence of malaria. This could explain why there is a significant difference between rate of cases existing and rate of cases detected. Judgement about this conclusion could only be made if the experiments were repeated in areas with a lower incidence of malaria.

v) Rate of cases detected by local operational services was low relative to the rate of cases reported by patients. Assuming reporting was accurate, this suggests that many people sought medical care in hospitals, clinics or services provided outside the villages.

If the Malaria Division were to apply the procedure to sample populations, both medical and malaria services in adjacent areas could be asked to provide information on confirmed cases from within the population. This would be a more reliable measure of cases detected than a questionnaire administered to the population. One defect of the approach followed is that positive cases identified are detected malaria parasite carriers and not

necessarily all the malaria cases. The case detection and treatment system through ACD and PCD rely on people being sick to be detected. Not all parasite carriers will be sick and therefore not all will be detected. The other factor of importance is the technology of detecting infection. Very often patients present themselves for treatment after the fever and therefore, depending upon the synchronization of the parasite cycle the number of broods and other factors, their parasites, although existing, may not be detected through examining a thick blood film taken from peripheral blood vessels.

4.2 Performance of Operational Services

Effectiveness or relative effectiveness in case detection (Section 4.1) is an important measure of the performance of a zone. Measurement provides a zone with a target to be achieved and allows comparison of the overall performance of each zone. But if a target of 100% effectiveness in case detection is to be achieved, attention has to be given to the performance of the component services and the way resources are deployed to provide services.

Direct comparison of the performance of operational services and occasional activities is constrained by three factors. Firstly, each service, such as malaria clinics, in a zone consists of several units operating in different sectors. A service is a collection of sub-units operating with different populations in different environments. Secondly, greater emphasis will be placed on particular types of services in each phase of a malaria control programme. The performance of "a" service is therefore affected by the combination and distribution of services within a zone in relation to a population and incidence of malaria in that population. Thirdly, the services within an area compete for clients from among the population.

The relative contribution made by a service to case detection is therefore a product of many factors including location of services in relation to the population, parasite incidence rate (PIR), nature and quality of services provided in addition to the crucial factors of organization and management. The results of several surveys to measure the performance of operational services are presented in this section.

4.2.1 Relative contribution of services

The relative contribution made by operational services and occasional activities is measured in terms of the number of blood slides collected by a service or number of positive cases detected through a service within a zone expressed as a percentage of the total number of blood slides or positive cases within the zone. (Tables 14 and 15 respectively).

Collection of blood slides

Three features are apparent from the data:

i) Hospitals make a major contribution to blood slide collection in Zone 3. Two factors may contribute to this situation. A significant proportion of the population at Zone 3 live in towns which are served by a large provincial and two district hospitals. Secondly, a large proportion of the population is in the consolidation and partial integration phase.

ii) Excluding hospitals, four operational services account for approximately 90% of all blood slides taken. In Zone 3, operational services show the following decreasing order of contribution. ACD>MVV>MC>VHC. In Zone 7 ACD>MC>MVV>VHC.

iii) Village health centres only make a small contribution to the collection of blood slides. This is perhaps surprising given the concept of partial integration phase. This may indicate competition with other services, perhaps that people would prefer to travel to a malaria clinic where diagnosis and radical treatment can be given immediately.

Detection of positive malaria cases

The most significant features of the data are:

i) Malaria clinics account for over 50% of all positive cases (hospitals included).

ii) There are significant differences between the relative contribution of the same services in the two zones.

iii) Active case detection particularly in Zone 3 has a very low slide positive rate.

Relative contribution in relation to relative cost

Of the operational services provided by the Malaria Division in Zones 3 and 7, four services ACD, MC, MVV and VHC account for the collection of 90% of blood slides and 90% of positive cases. The performance of each service in relation to costs is therefore an important issue.

Relative contribution for each of these four major services in Zones 3 and 7 is the number of blood slides collected by each service expressed as a percentage of blood slides collected by the four services and number of positive cases detected by each service expressed as a percentage of positive cases detected by the four services. Relative cost is the total direct and indirect internal cost of each service expressed as a percentage of the total internal cost of all four services.

TABLE 14

RELATIVE CONTRIBUTION OF OPERATIONAL SERVICES AND OCCASIONAL ACTIVITIES IN THE COLLECTION OF BLOOD SLIDES (JAN-DEC 1980)

Operational Services and occasional activities	Relative Contribution % Hospitals Included		Relative Contribution % Hospitals Excluded	
	Zone 3	Zone 7	Zone 3	Zone 7
1) Active Case Dectection	19.4	46.4	30.2	47.4
2) Malaria Clinic	15.5	19.1	24.0	19.6
3) Malaria Village Volunteers	17.7	14.0	27.5	14.4
4) Hospital	35.7	2.3	-	-
5) Village Health Centre	7.1	4.8	11.1	4.9
6) Case Investigation	3.3	5.9	5.1	6.0
7) Follow-up	0.4	0.3	0.6	0.3
8) Mass Blood Survey	0.1	3.2	0.2	3.3
9) Special Survey	0.2	1.8	0.3	1.9
10) Mobile Clinic	0.6	2.2	1.0	2.2
	100%	100%	100%	100%

RELATIVE CONTRIBUTION OF OPERATIONAL SERVICES AND OCCASIONAL ACTIVITIES IN THE DETECTION OF POSITIVE MALARIA CASES (JAN-DEC 1980)

TABLE 15

Operational Services and Occasional Activities	Relative Contribution % Hospitals Included		Relative Contribution % Hospitals Excluded	
	Zone 3	Zone 7	Zone 3	Zone 7
1) Active Case Detection	2.1	16.3	2.9	17.0
2) Malaria Clinics	57.0	55.5	81.1	58.2
3) Malaria Village Volunteers	7.5	14.2	10.7	14.9
4) Hospitals	29.7	4.5	-	-
5) Village Health Centre	2.8	4.6	4.0	4.8
6) Mass Blood Survey	0.3	2.3	0.4	2.4
7) Special Survey	0.2	0.9	0.3	0.9
8) Mobile Clinic	0.4	1.7	0.6	1.8
	100%	100%	100%	100%

Two features present themselves: the relative efficiency of services within each zone (output SPR/input cost) and the comparative efficiency of the same services in the two zones.

The decreasing order of efficiency in Zone 3 is MC>VHC>MVV>ACD. In Zone 7 VHC<MC<MVV<ACD. It is interesting to note that village health centres appear to show a similar efficiency as malaria clinics. This is because the cost of VHC's does not include the cost of staff. Salaries and wages of staff in village health centres are met by the Ministry of Health and not the malaria service. The low efficiency of ACD and MVV is clear in both zones. It has to be acknowledged that efficiency will be affected by the development of different operational services in different phases.

Comparison of services in the two zones shows that Zone 3 has a very low efficiency in relation to Zone 7. A factor apparent in studies of cost/case and cost/patient (Section 4.7).

4.2.2 Time taken to provide radical treatment

To reduce sickness, the probability of transmission and to prevent death, the time between evidence of infection with malaria parasites and radical treatment should be as short as possible. Records of action taken with all positive cases (MS8 forms) during January-December 1980 were reviewed for Zones 3 and 7 in Region 1. The time between taking a blood slide and providing radical treatment was noted for each patient. The average time (days) for each operational service and occasional activity in the two Zones is shown in Table 16.

The average time between taking a blood slide and providing radical treatment shows a similar trend in the two zones studied: malaria clinics>hospitals>MVV>VHC>ACD. While the mean time in providing radical treatment is marginally shorter in Zone 3 (4.0 days) than in Zone 7 (4.2 days) most of the operational services in Zone 3 take a statistically significant longer time than Zone 7. This apparent contradiction occurs because a larger proportion of cases in Zone 3 are detected at malaria clinics where the average time is short at only 1.3 days.

But conclusions drawn from the data must be treated with caution. In both zones monitoring records (MS8 forms) are incomplete. There is no recorded date of treatment for 11.2% of positive cases in Zone 3 and 3.9% of cases in Zone 7. Study of hospital records also show that many malaria cases diagnosed and treated in hospitals are not notified to or recorded by the malaria service.

But even acknowledging doubts about the reliability of data two conclusions are clear. Firstly, malaria clinics provide a very swift service compared with all other major operational services. Secondly, the longer average time taken to provide treatment by operational services in Zone 3 and the high percentage of incomplete records in the zone may be a reflection of the quality of workers involved in each activity or suggests that Zone 3 has less stringent control of surveillance and monitoring operations than Zone 7.

4.2.3 Effectiveness in providing radical treatment

The average time taken to provide radical treatment by each operational service provides a useful measure of performance to be improved by each zone and a comparative measurement among zones. But a measurement of performance which more clearly reveals the number of cases who could be active carriers is the percentage effectiveness in providing radical treatment.

TABLE 16

AVERAGE TIME BETWEEN TAKING A BLOOD SAMPLE
AND PROVIDING RADICAL TREATMENT

Operational Service and Occasional Activities	ZONE 3		ZONE 7		T test of significant difference between means <0.01
	Relative Contribution (%)	Average Time (Days)	Relative Contribution (%)	Average Time (Days)	
1. Malaria Clinic	71.6	1.3	51.7	1.2	S
2. Malaria Village Volunteer	14.7	11.1	17.4	7.8	S
3. Active Case Detection	4.7	15.9	16.6	8.1	S
4. Village Health Centre	4.9	13.8	4.2	8.4	S
5. Hospital	2.1	8.8	3.4	5.9	NS
6. Case Investigation	0.5	6.9	0.1	10.0	NS
7. Mass Blood Survey	0.1	7.7	2.0	6.7	S
8. Follow-up	0.1	23.8	0.0	0.0	S
9 Special Survey	1.4	2.4	4.6	6.0	
Mean		4.0		4.2	
Standard Deviation		6.6		4.6	
N	4,387		12,029		
Missing cases %		11.2		3.9	

$$= \frac{\text{number of cases provided with radical treatment within a target time}}{\text{number of cases which should be provided with radical treatment within the target time}} \times 100$$

Over 90% of positive cases attending malaria clinics received radical treatment within one day. Over 90% of cases detected through ACD, MVV and VHC took more than one day.

If presumptive treatment administered by the malaria and medical service on taking blood slides is effective in preventing transmission for 10 days, many patients in both zones will exist as active carriers before radical treatment is administered. The number of patients without radical treatment after ten days is 545 in Zone 3 and 1,122 in Zone 7. The number of man days these patients could be active carriers is approximately 9,000 in Zone 3 and 16,000 in Zone 7.

If presumptive treatment is ineffective in preventing transmission the situation is far more worrying. The number of man days patients could be active carriers is then approximately 11,000 in Zone 3 and 41,000 in Zone 7. The high figures in Zone 7 are a reflection of the high incidence of malaria rather than any marked deficiency in operational services. When the time that cases are potential carriers is expressed as man days/positive case, Zone 3 shows a poorer performance than Zone 7; approximately 12 man days/positive case in Zone 3 and approximately 8 man days/positive case in Zone 7.

The value of malaria clinics in providing immediate blood slide examination and radical treatment compared with the slow treatment time of MVV and ACD is clearly illustrated using this measurement of performance.

But the number of active carriers in a zone is not simply dependent upon effectiveness in providing diagnosis and radical treatment. At least four other factors affect the size of the pool of active carriers in a zone.

i) Patient performance in seeking diagnosis and treatment

Most positive cases will be active carriers before presenting themselves for diagnosis and treatment. In a study of cases treated at malaria clinics (Section 4.10) 20% of patients took more than 10 days after the onset of symptoms before seeking care. Similar studies are needed of response to other services.

ii) Asympomatic cases

A number of cases may be asymptomatic or the effects of infection sufficiently mild that carriers do not seek treatment.
A small sample study of 17 villages with 4,159 population showed that from 3,887 people screened by MBS (272 missing cases) 0.85% non fever population were found to be positive for asexual forms of P. falciparum and P. vivax.

iii) In-effectiveness of presumptive treatment

It is reported that many types of malaria in Thailand do not respond to presumptive treatment. This means that infected individuals remain as active carriers until effective radical treatment is given.

iv) In-effectiveness of radical treatment

Radical treatment may not effect a cure and prevent transmission. Systematic follow up of a small number of cases in the two zones shows that 20% were still positive after 4 months. These cases are viewed technically as reinfected. But these cases could equally well be non-responsive to radical drug therapy or could have failed to take the drugs prescribed.

In a survey of four villages with patients studied every 5 days, 28 of 63 cases detected were repeat positives on everything from 5 to 30 days later. Eleven of the cases failed to take the radical drug properly. The figure could be expected to be higher where patients are not closely monitored.

4.3 Performance of ACD

Excluding the hospital service Active Case Detection (ACD) accounts for approximately 30% of blood slides collected in Zone 3 and approximately 50% of blood slides in Zone 7. Slide positive rates from ACD are the lowest of the major services 0.7% in Zone 3 and 3.1% in Zone 7. ACD in both zones account for a little over 30% of expenditure on the four major operational services. The effectiveness of ACD is therefore a matter of considerable concern. The goal of ACD is different depending upon the phase but how can the performance of ACD operations be assessed? Efforts were made in Zones 3 and 7 to determine the performance of house visiting (obtaining response from residents in houses to be visited) and the performance of house visitors (following procedures to gather data and where appropriate blood slides from each household visited).

Performance was measured through (i) analysis of monitoring forms MS1, $MS1_a$, $MS1_b$ and $MS1_d$ to determine performance of house visiting and (ii) primary surveys to check on the performance of house visitors.

Results were obtained only for Zone 7. In Zone 3 measurement of the performance of house visiting was not possible because monitoring forms were incomplete or missing. Primary surveys could not be conducted in Zone 3 because personnel were not available.

4.3.1 Performance in house visiting

Study of monitoring forms MS1, $MS1_a$ (daily report of house visitors) $MS1_b$ (schedule for house visiting) and $MS1_d$ (monthly report on ACD) provides information on performance in house visiting; effectiveness in house visiting and effectiveness in undertaking interviews.

When anomalies and omissions in the monitoring forms had been reconciled the following results were obtained for Zone 7.

i) Effectiveness in house visiting

Percentage effectiveness in house visiting in 1980 was 99.3%.

$$\text{Percentage effectiveness in house visiting} = \frac{\text{Number of houses visited}}{\text{Number of houses to be visited (target)}} \times 100$$

A 99.3% effectiveness could suggest that the performance of house visitors in following procedures is very high. But the statistics fail to reveal what occurred when each house was visited. Outcome from visiting is affected by the number of households actually interviewed and the quality of

the interviews (Section 4.3.2).

ii) Effectiveness in undertaking interviews

The percentage effectiveness in undertaking interviews was 32.9%

$$\text{Percentage effectiveness in undertaking interviews} = \frac{\text{Number of houses where interviews were conducted}}{\text{Number of houses to be visited (target)}} \times 100$$

The percentage effectiveness in undertaking interviews is based upon the total number of houses where interviews were conducted within the year.

Low effectiveness in undertaking interviews arises for three reasons:

a) In 29.6% of houses visited the houses were closed or no member of the household was available for interview.

b) In 13.6% of houses visited the households had moved from the area.

c) In 23.1% of houses visited interviews could not be conducted for other reasons.

The statistics do not indicate how many houses were consistently interviewed as required by ACD procedures at least once/month.

4.3.2 Performance of house visitors

Three primary surveys were undertaken in Zone 7 in different areas and seasons to monitor the performance of house visitors. A one month survey was first conducted by sector chiefs in their own areas. For second and third surveys (2 months and 1 month respectively) squad chiefs were used to monitor the performance of house visitors in areas outside their responsibility.

Sector chiefs and squad chiefs visited houses one day after calls had been made by house visitors to check on performance of the required procedures: house visiting, questioning households, taking blood slides, providing radical treatment and the maintenance of record cards. Random checks were made each day to monitor the performance of house visitors.

Performance of house visitors is based upon the number of houses where monitoring personnel were able to secure interviews with householders; 87.0 to 94.6% of the target households.

Examination of the overall performance of the three surveys shows a number of important features:

i) Effectiveness in house visiting (66.3%) is low in relation to the effectiveness (91.1%) reported by those who monitored the performance of house visitors. A number of houses (12.1%) were not visited even though householders were available for interview.

ii) Where the number of target houses includes only a count of the number of houses visited, effectiveness in undertaking interviews is high (93.3%). However, the real percentage effectiveness of interviewing in cases where the count of target houses include all sample houses to be visited, the percentage is much lower (61.8%).

iii) Effectiveness in taking blood slides is low at 53.9%.

Effectiveness in taking blood slides = Number of blood slides taken (from patients with a history of fever) / Number of blood slides which should be taken (from patients with a history of fever) x100

Percentage effectiveness in taking blood slides is based upon the population interviewed by the monitoring personnel. Effectiveness will be affected by the performance of the patient, i.e. refusal to give a slide, in addition to the performance of the HV. Failure of the house visitors to conduct interviews in 33.7% of the households does not account fully for the low effectiveness. Effectiveness in collecting blood slides is therefore low because (a) many households are not interviewed; (b) blood slides are not taken from individuals where interviews would suggest that slides should be collected.

iv) Effectiveness in giving presumptive treatment was overall 48.8%.

Effectiveness in giving presumptive treatment = Number of patients given presumptive treatment / Number of patients from whom blood slides should be taken x 100

According to the patients presumptive treatment was not given to 5.1% of the patients who gave blood slides to house visitors.

v) About 12% of houses have no record cards on which to record details of calls by house visitors.

The results of monitoring procedures of house visitors are important for two reasons. Firstly, the three surveys show some consistency and therefore suggest reasonable reliability. The "good" results of the third survey probably reflects house visitors becoming aware that studies were being made of their performance. Secondly, the low performance levels show that procedures are not being followed. This will mean in-effectiveness in case detection and the existence of a significant number of people in the population with malaria; a pool of people who will contribute to the continued transmission of malaria.

4.4 Performance of Laboratory Services

Five aspects of laboratory services are reviewed in this section to show the levels of performance achieved and to describe how measurements are made. Performances measured are: effectiveness in completing examination of a target number of blood slides; effectiveness in the identification of positive cases and parasite species; and time taken to complete microscopic examination of blood slides and notify the sector chief.

4.4.1 Effectiveness in completing examination of blood slides

Monitoring forms L6 list a target number of slides to be examined each month by microscopists in the zone and the number of slides actually examined. Percentage effectiveness in completing examination of blood slides can therefore be measured as

= number of blood slides examined within a period of time / target number of blood slides to be examined x 100

Review of a 30% random sample of LS6 forms for 1980 showed a 92% effectiveness in Zone 3 and a 98% effectiveness in Zone 7.

Although the percentage effectiveness, particularly for Zone 7, would seem to be satisfactory the significance of these performance figures is open to question.

Target figures vary from month to month by as much as 100% without any reference to the number of microscopists involved. One is led to the conclusion that targets are simply the number of blood slides presented for examination each month. If this is the case, effectiveness in the examination of blood slides does not reflect the performance of microscopists. A 98% effectiveness in examining blood slides could mean that 10 microscopists examined 1,470 of 1,500 slides one month and 2,940 of 3,000 slides in the following month. The only value in the measurement is the indication of the percentage of slides carried over from the last day in one month to the first day of the succeeding month.

Perhaps a more relevant measure would be effectiveness in relation to a stipulated target of 70 slides per day.

4.4.2 Effectiveness in the identification of positive cases and parasite species

Procedures require that all positive blood slides and a proportion of negative slides are checked at the regional and divisional laboratory. 10% of the negative slides examined at the zone level and all the positives are sent to the regional laboratory for checking. At the regional laboratory 25% of the positives and 1% of the negatives are sent to the divisional laboratory before being checked. The remaining 75% of positive and 10% of negatives are checked for accuracy with 10% of all these slides mixed and sent to the divisional laboratory.

Monitoring records for Zones 3 and 7 in Region 1 for 1980 were examined to determine the proportion of slides re-checked at each stage and to assess the performance of zone microscopists in correctly identifying positive cases and parasite species.

Monitoring records show that a little over 8% of negative slides from Zones 3 and 7 were checked at Regional Headquarters and approximately 0.7% checked at the Division. Of the checked negative slides 0.71% in Zone 3 and 0.34% in Zone 7 were found to be positive. Assuming the sample checked is representative of all slides found to be negative, this means that 468 people in Zone 3 and 438 people in Zone 7 were incorrectly diagnosed as negative in 1980. If percentage effectiveness is identification of positive cases

$$= \frac{\text{number of slides found to be positive}}{\text{number of positive slides}} \times 100$$

then the effectiveness of positive case identification in 1980 was 92% in Zone 3 and 96.5% in Zone 7.

Of the slides found to be positive in Zones 3 and 7 approximately 60% were re-checked at Regional Headquarters and approximately 17% re-checked at the Division. Incorrect identification of species was found in 0.06% of slides in Zone 3 and 0.23% of slides in Zone 7.

4.4.3 Time taken to complete microscopic examination of blood slides and report results to sector chief

Overall time between taking a blood slide and providing radical treatment (Section 4.2.2) has, in principle, three components: time between taking a blood slide and completing microscopic examinations, time between completing microscopic examination and notification of the sector chief, and time between notification of the sector chief and the provision of radical treatment to the patient.

There are two exceptions to this general principle. In malaria clinics the sector chief need not be notified before treatment is given. In Zone 7 the sector chief need not be notified if another person is doing the case investigation; he may be notified after the radical treatment has been given, particularly in the case where slides from PCD and ACD are examined in a free standing clinic.

The performance of microscopists is an important element in the total time between taking a blood slide and completing microscopic examination. But the time will also depend upon the time taken to deliver a slide to a microscopist. Time taken to notify the sector chief that a case is positive is largely a matter of speed of communication systems. Dates when action is taken with positive cases are recorded in a case monitoring form MS8.

The results show the following features:

i) Time between collecting a blood slide and completing microscopic examination takes between 5 to 8 days on average for ACD, VHC and MVV. Malaria clinics take approximately 1 day since blood slides are examined as patients present themselves.

ii) A significant difference is evident in the time taken for each service and in the comparative performance of Zones 3 and 7.

iii) Average time between completing microscopic examination and notifying the sector chief is almost as long as the average time between taking the blood slide and completing microscopic examination. In malaria clinics this apparent delay is not important since radical treatment is not dependent on notification of the sector chief. In other cases where treatment is dependent upon notification of the sector chief, speed in providing radical treatment is important to the patient and important in minimizing possible transmission of infection.

iv) Zone 7 shows two interesting features in the time taken to notify the sector chief. Time taken for ACD is relatively short 2.9 days on average, where speed is important. Time taken from malaria clinics, where speed is not important, is approximately 4 days. This clearly shows that management procedures can affect the overall time taken between taking a blood slide and providing radical treatment.

4.5 Performance in Case Investigation and Follow-Up

An important feature of surveillance procedures developed for the malaria eradication strategy was case investigation and follow-up.

Case investigation to locate collateral cases and possible sources of infection requires the taking of blood slides from the case under investigation and completion of monitoring form MS6 through guided interview. Slides may also be taken from neighbours and others at risk (MBS slides). Case follow-up procedures require the taking and checking of blood slides from positive patients after a positive case is identified.

It would seem, in principle, possible and useful to examine the effectiveness of both procedures. However, in a control strategy epidemiological investigation of individual cases is thought to be of little value (Beales 1979). Since there is no fixed (required) target, measures of effectiveness reflect the outcome of the control strategy rather than operational performance.

4.5.1 Case investigation

If case investigation is to be a required procedure in all phases of the control strategy, percentage effectiveness in case investigation could be expressed

$$= \frac{\text{number of cases investigated in the year}}{\text{number of positive cases detected in the year}} \times 100$$

Data on the number of case investigations undertaken within each zone may be gathered from the recorded forms for each case (MS8), from case investigation interview forms (MS6) and from monthly reports of case investigation MS7.

The total number of positive cases are 7,167 cases in Zone 3 and 12,600 in Zone 7. (Data drawn from monthly reports of passive case detection (MS5) and active case detection (MS3)). Collated MS7 forms for 1980 show 3,787 case investigations in Zone 3 and 10,171 in Zone 7. Collated MS8 forms for 1980 show 3,636 case investigation slides in Zone 3 of which 1,850 (50.8%) are positive and 8,489 case investigations in Zone 7 of which 1,809 (21.3%) are positive.

Using the data from collated MS7 forms shows a 58.2% effectiveness in case investigation in Zone 3 and 80.7% in Zone 7.

Case investigation slides are taken when the person being treated is actually met with and interviewed. The low number of slides in relation to cases shows that slides are not always taken on case investigation. In many cases doses of medication may have to be left with neighbours or friends and many case investigations may be completed second hand by asking a family member, neighbour or the local MVV.

The low number of positive slides may reflect many factors; presumptive treatment may reduce evidence of infection or act as a cure, the length of time may lead the patient to self-treatment or treatment elsewhere, or there could be errors in monitoring.

Effectiveness in case investigation could be a useful tool if completed by phases and judged in relation to a particular policy. The blanket analysis completed in this case merely indicates that effectiveness is understandably low in zones as a whole.

4.5.2 Follow-up

Performance in follow-up may be determined through collation of data from the records of individual cases (MS8 form). There are several striking

features of the data for the period January - December 1980 for Zones 3 and 7:

i) Percentage effectiveness in regular follow-up for 6 visits is extremely low, e.g. 0.1% in Zone 3 and 0% in Zone 7, based upon total numbers shown in MS8 form. This is not unexpected since follow-up is not a requirement in the control strategy. The question is whether follow-up should remain as a general procedure or simply be used as a tool for investigation of the effectiveness of drug treatment.

Percentage effectiveness in regular follow-up for 6 visits

$$= \frac{\text{number of cases followed up for the required 6 visits}}{\text{number of positive cases to be followed up}} \times 100$$

ii) Of the total number of positive cases recorded in MS8 forms only 5.1% in Zone 3 and 0.47% in Zone 7 were followed up after the first month.

iii) Data from the frequency of irregular visiting cannot be used to determine the percentage of patients followed up for the first month. The cumulative total of 5.85% in Zone 3 and 0.11% in Zone 7 only shows the percentage of cases followed up at least once - but not necessarily in the first month.

iv) Of the small number of cases followed up regularly approximately 18% in Zone 3 and 50% in Zone 7 were still positive after 2 months. Of the 8 cases in Zone 3 followed up for 5 months 50% were still positive.

v) The total number of cases followed up regularly for 1 month (MS8 forms) is at variance with figures reported directly by the zones.

4.6 Performance in Monitoring

Monitoring is the system developed to record the nature and outcome from surveillance activities. The records provide information on which decisions affecting surveillance activities may be based. The system of monitoring is shown in Table 2.

Of the approximately 50 forms used in monitoring malaria activities, 21 are used in surveillance. The most important of these forms is MS8: malaria case registration form. The MS8 form records for each patient the patients name; operational service through which the case was identified; dates on which blood slides are taken; microscopic examination completed; results reported to zone chief and radical treatment provided; the results of case investigation and follow-up.

Monitoring forms are clearly important in communicating what action has and should be taken in the surveillance with each case. If correctly completed monitoring forms also provide vital statistics and information on the performance of surveillance procedures.

But monitoring is not always effective. For example, the number of positive cases evident from MS8 forms is markedly different from the number of cases reported by zones. For Zone 3, 3,862 cases are shown in MS8 forms with 7,167 cases reported by the zone. In Zone 7, 11,832 cases are shown in MS8 forms and 12,600 reported by the zone.

Similar discrepancies are apparent in the follow-up of cases after 1 month. For Zone 3 MS8 forms show 226 cases followed up after one month compared with 88 reported from zones. For Zone 7 MS8 forms show 20 compared with 103 reported by the zone.

As a result of these discrepancies all data drawn from monitoring forms must be analyzed and viewed with caution.

In an effort to systematically assess performance in monitoring, performance in completing entries was determined. Zones 3 and 7 were asked toprovide completed MSI_b, MSI_c, MSI_d, MS7 and MS8 forms for 1980.

Collation of the entries in the forms yielded the number of entries, percentage of entries completed in each column of each form and the percentage of entries fully completed. Zone 3 was unable to provide complete records of a number of forms. Three comments present themselves:

i) The percentage of completed items varies widely; 0% for MS8 and 93% for MSI_b.

ii) Many columns, particularly in MS8 are not being completed or the activity is not being pursued It would seem appropriate for the Malaria Division to review the forms and consider in view of the change in strategy what forms are necessary and why, what procedures should be rigorously applied and which columns might be dropped from the forms.

iii) Completion of entries is not a sound basis for assessing the performance of monitoring. Consistency and reliability in entries would provide a better basis for evaluating the performance of surveillance activities. But such a survey was an impossible task with the resources available.

4.7 Cost per Patient and Cost per Positive Case

Determining the total cost of each operational service (Section 3) allows analysis of the distribution of a zone's expenditure among operational services, analysis of the proportion of direct and indirect cost to each service and comparison of the level and pattern of costs among zones. But a more relevant and critical analysis of costs can be made when costs of each service are related to the performance of each service. The most reasonable measures of performance are the number of blood slides collected and examined (number of patients) and the number of positive cases detected.

Costs per patient and costs per positive case for each operational service in Zones 3 and 7 are presented in Tables 17 and 18 respectively.

Costs per patient and costs per positive case for the hospital service represent not the total cost of case detection and treatment. Costs shown are only the costs incurred by the malaria service in providing epidemiological support. Total costs will also include direct and indirect expenditure by the hospital on suspected malaria cases and on positive cases as described in Section 3.5.

4.7.1 Cost per patient

The average cost per patient in Zones 3 and 7 (Region 1) is approximately 30 Baht and 20 Baht respectively. Costs for each service (neglecting

TABLE 17

COST PER PATIENT FOR OPERATIONAL SERVICES AT ZONE LEVEL : ZONES 3 & 7

COST/PATIENT BAHT / COST ITEM	TOTAL	ACD	MC	MVV	HOSP.	VHC	CI	FU	MBS	SS	MOBILE
					ZONE 3						
Lab & Treatment	16.2	18.7	3.2	27.6	-	16.1	3.4	24.1	17.8	6.3	3.0
Epidem (Monitoring)	10.1	0.8	29.1	3.4	6.6	3.1	61.9	26.7	25.8	10.3	4.9
Total Direct	26.3	19.5	32.3	31.0	6.6	19.2	65.3	50.8	43.6	16.6	7.9
Total Indirect	7.2	17.5	4.5	13.4	0.1	7.5	1.2	7.6	12.9	3.6	-
Total Cost	33.5	37.0	36.8	44.3	6.7	26.5	66.5	58.4	56.5	20.2	7.9
					ZONE 7						
Lab & Treatment	10.7	8.4	4.1	33.1	-	10.7	4.5	12.6	6.6	3.9	3.3
Epidemiology	7.8	2.4	19.7	6.8	13.4	6.5	16.6	17.6	4.9	2.9	5.6
Total Direct	18.5	10.8	23.8	39.9	13.4	17.2	21.1	30.2	11.5	6.8	8.9
Total Indirect	3.1	3.2	2.2	7.2	0.4	1.6	0.5	-	0.6	-	0.1
Total Cost	21.6	14.0	26.0	47.2	13.8	18.7	21.5	30.2	12.0	6.8	9.0

TABLE 18

COST PER POSTIVIE CASE FOR OPERATIONAL SERVICES AT ZONE LEVEL: ZONES 3 & 7

COST ITEM \ COST/CASE BAHT	TOTAL	ACD	MC	MVV	HOSP.	VHC	CI	FU	MBS	SS	MOBILE CLINIC
					ZONE 3						
Lab & Treatment	164	2,748	13	1,004		626	6	114	104	79	66
Epidemiology	122	122	122	122	122	120	122	126	152	131	107
Total Direct	286	2,870	135	1,126	122	746	128	240	255	210	173
Total Indirect	87	2,566	19	490	2	292	3	36	76	46	-
Total Cost	373	5,436	154	1,616	124	1,038	131	276	331	256	173
					ZONE 7						
Lab & Treatment	108	273	16	374	-	129	21	55	103	99	46
Epidemiology	78	78	78	77	77	79	78	76	77	75	78
Total Direct	186	351	94	451	77	208	99	131	180	174	124
Total Indirect	31	105	9	82	2	20	2	-	9	-	2
Total Cost	217	456	103	533	79	228	101	131	189	174	126

hospitals) range from 8 to 67 Baht per patient in Zone 3 and from 7 to 47 Baht per patient in Zone 7. Most of the operational services in Zone 3 are more expensive (cost/patient) than Zone 7.

There is no consistent order to the cost of services. In terms of the major operational services, the decreasing order of costs in Zone 3 is MVV>ACD>MC>VHC with MVV<MC<VHC<ACD in Zone 7. In both zones malaria village volunteers are the most expensive of the major operational services at approximately 44 to 47 Baht/patient.

Component costs show a consistent pattern although magnitudes are different in each zone. The ratio of laboratory and treatment cost to epidemiology is greater than 1:1 for ACD, MVV and VHC, approximately 1:1 for FU, MBS, SS and mobile clinics and less than 1:1 for MC and CI. Indirect cost per patient is consistently lower in Zone 7 than Zone 3; 50% on average.

Without consideration of the number of positive cases the cost/patient for each service allow for three observations:

i) Neglecting other functions, MVV is an expensive way to collect blood slides at a low level of usage and using current operational systems. Other social functions served by MVV are not considered in this analysis.

ii) If operational services are found to be very expensive, can and should the form of these services be modified?

iii) Since cost/patient for operational services in Zone 3 is consistently higher than Zone 7, does this indicate that tighter control is required in Zone 3? If the cost/patient was determined for more zones, could a target cost be established?

4.7.2 Cost per positive case

The average cost per positive case in Zones 3 and 7 (Region 1) is 373 Baht and 217 Baht respectively. Costs for each service, neglecting hospitals, range from approximately 130 to 5,400 Baht/positive case in Zone 3 and from 100 Baht to 530 Baht/positive case in Zone 7. All of the operational services in Zone 3 are significantly more expensive than Zone 7 with a factor of approximately ten times for ACD service.

In Zone 7, the cost per positive case of the major operational services are approximately in the ratio 1:2:4:5 (MC:VHC:MVV:ACD). Using the cost/case of MC in Zone 7 as a base, costs of major operational services in Zone 3 are approximately 1.5:10:16:55 (MC:VHC:MVV:ACD). The consistently low cost of malaria clinics arises because of the low cost/case of laboratory and treatment. The high costs for MVV, VHC and ACD are linked to the time cost of personnel supervising and providing treatment.

In economic terms, without considering the effectiveness in identifying positive cases and other roles served by ACD and MVV personnel, there is need to consider whether ACD, MVV and VHC services can and should be continued. It is certainly difficult, in economic terms to justify continuation of ACD, MVV and VHC services in Zone 3 as they stand, with the existing cost levels.

4.8 Cost per Patient in Malaria Clinics

Approximately 20% of blood slides and 50% of positive cases are handled by malaria clinics in Zones 3 and 7 in Region 1. Of the major operational services malaria clinics have the lowest internal cost/positive case. Given the high performance and low internal cost/case it is to be expected that the number of malaria clinics could increase. It is appropriate therefore to explore the cost of malaria clinics in relation to size and performance. Is there an optimum economic size?

4.8.1 Direct internal cost

Staff in malaria clinics take stain and examine blood films from patients calling at the clinics and also examine blood films collected through other operational services. Clinic patients can represent anything from 5-75% of the total slides examined. Total internal costs will be affected by several factors; salary and welfare of microscopists and assistants, remuneration, supplies, depreciation of fixed assets and expenditure on slides, chemicals and drugs prescribed to positive cases.

Analysis of data for Zone 7 for 1980 and 1981 shows that the average annual cost/microscopist or assistant (very similar salaries) was approximately 20,600 Baht. Cost of materials is approximately 0.15 Baht/slide examined for slides and chemicals with drugs for radical treatment, approximately 6 Baht/positive clinic case.

(This average cost takes into account the dose prescribed to children and adults and the relative number of child and adult patients).

Neglecting costs of any presumptive treatment, given only in some cases, the cost/patient

$$= \frac{21{,}300\ P + 0.15\ S + 6\ Sp}{S}$$

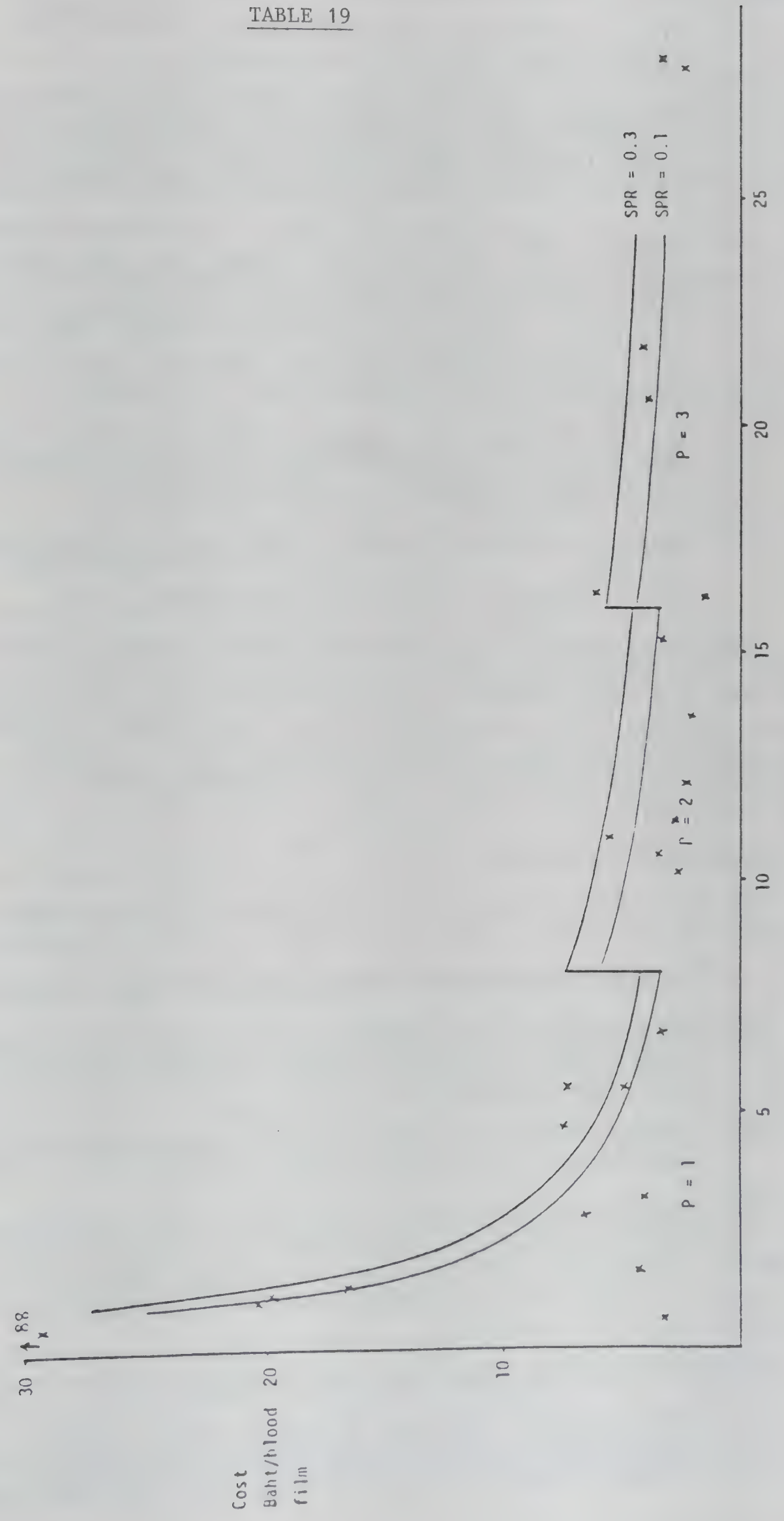
where P = number of personnel
S = number of blood films examined
Sp = number of positive clinic patients

A general curve of cost/slide in relation to number of slides can be drawn if it is assumed that Sp, the number of positive slides, is the total number of blood films examined times SPR (slide positive rate) (Table 19). This relationship marginally over-estimates the number of clinic cases receiving drugs and the total cost of drugs.

A change in staffing levels from P = 1 to 2 and 2 to 3 will produce a significant increase in the cost per blood film. At what load levels (blood film examinations/year) may an increase in staff levels be expected? And how do the cost of malaria clinics relate to the general cost curve.

The maximum throughput for a microscopist is approximately 16,000 blood film examinations/year. This assumes a daily examination rate of 70 blood film examinations/day with a 5 day working week and 25 days annual leave and public holidays. If no assistance is provided, microscopists will also be involved in taking blood films from clinic patients, monitoring, and providing advice and treatment. Under such circumstances, a daily examination rate of 35 blood films might be more realistic. A step in staffing levels from 1 to 2, or 2 to 3 can therefore be expected at 8,000 and 16,000 blood film examinations/year.

TABLE 19


MALARIA CLINICS : DIRECT INTERNAL COST PER BLOOD FILM
Cost Baht/blood film
30
20
10
88
SPR = 0.3
SPR = 0.1
P = 3
P = 1
P = 2
5
10
15
20
25
Number of blood films (patients) x 10^3

When the direct internal expenditure at malaria clinics in Zones 3 and 7 is compared with the general curves, several observations can be made:

i) Direct expenditure at malaria clinics with more than 1,000 patients varies between 1.8 and 20 Baht/patient.

   Average costs in 1980-82 are approximately 3.1 Baht in Zone 7 and 7.6 Baht in Zone 3. These figures compare favourably with the direct laboratory and treatment cost of 3.2 and 4.1 Baht/case obtained through the apportionment of zone expenditure.

ii) Assuming a microscopist can examine approximately 8,000 blood films/year in a malaria clinic, costs will rise sharply as the number of staff is increased to cope with additional work load. A rise from 3 - 6 Baht/case will occur at approximately 8,000 slides if staff are increased from 1 to 2 (S = 0.1). Similarly at approximately 16,000 slides/year costs will rise from 3.5 to 5 Baht/patient if a third microscopist is employed.

iii) The cost per patient at most malaria clinics falls within or below the curve of cost/patient. This is probably because the possible work load/microscopist is under-estimated.

   Malaria clinics set up with a small number of patients/year may be expected to have a high cost/patient due to salaries. Costs can only be reduced by increasing the catchment areas.

Under-utilization of facilities is clearly a matter of concern. One possible solution may be to establish outreach clinics which visit two or three areas/week on a regular basis. This could increase the catchment area of the clinics, increase utilization of facilities, yield faster treatment relative to other operational services and reduce external costs to patients. Locations would have to be determined in relation to incidence of malaria, population density and terrain.

4.8.2 Total cost per patient

The total cost per patient attending malaria clinics depends upon the definition of total cost. Three alternatives are to be considered:

i) internal direct cost + patients external direct explicit cost;

ii) internal direct and indirect cost + external direct explicit and direct implicit cost of patients (neglecting estimated time cost after attending malaria clinic);

iii) internal direct and indirect cost + external direct cost of patient and indirect cost of relatives.

The internal cost per patient at malaria clinics is approximately 26 Baht. This may be compared with total costs of 74 Baht, 349 Baht and 849 Baht per patient respectively for the three alternatives. Internal cost is approximately 32.5% in case (i), approximately 7.4% in case (ii) and approximately 3.1% in case (iii).

Several features of these costs are important:

i) 70% to 90% of total cost is external cost incurred by the patient. Higher direct expenditure per case can be justified if such expenditure was to reduce the total cost per case (external and

internal). External costs are incurred generally by people in the low income sector of the population. Government expenditure which provides more convenient supply therefore yields a re-distribution of income.

ii) The level of external costs could probably be reduced if treatment centres were more conveniently located relative to the populations served. Optimum location of services could reduce travelling cost and time off work before attending the malaria clinic. Health education could also reduce the overall cost if it encouraged fever cases to attend clinics earlier.

iii) External direct explicit cost of travelling (approx. 20 Baht) is high in relation to daily income and in relation to the internal cost/case at a malaria clinic.

iv) The cost of self-prescribed drugs (approximately 30 Baht) is high in relation to the cost of radical treatment through the malaria service (approximately 6 Baht). It is claimed that the effectiveness of radical treatment is reduced by inappropriate self-prescription of drugs. An increase in the effectiveness of radical treatment and reduction in overall cost might be expected if access to malaria clinics was more convenient, i.e. average travelling time reduced.

Judgement about the merits of particular operational services should be based on minimizing the overall cost to a population rather than minimizing the internal cost to the malaria service. However, minimizing costs should be secondary to providing effective control.

In rural areas relatives frequently accompany patients attending clinics. If explicit and implicit indirect cost of relatives is also included (84 Baht), the total cost/patient is approximately 849 Baht. Arguments presented earlier for reducing external costs are further reinforced.

4.9 Cost of Malaria Inpatients and Outpatients Treated in Hospital

An outpatient visit by a suspected malaria case would cost approximately 45 Baht/person plus the cost of any drugs prescribed. The total cost of a malaria outpatient visit to the hospital is approximately 127 Baht with 60% of the cost due to the cost of drugs. To this cost must be added costs incurred by the Malaria Division in monitoring/epidemiology estimated to be 77 and 122 Baht/case (Zones 7 and 3 respectively).

The total internal cost of a malaria outpatient (assuming one visit) is approximately 210-250 Baht. (Internal is internal to the hospital and malaria services). Costs are higher than in malaria clinics but lower than costs found for other operational services such as ACD and MVV (See section 4.7).

Malaria inpatients are significantly more expensive than outpatients. For the average 4 day stay in hospital a malaria case costs approximately 952-1,000 Baht; approximately 20% for drugs and 10% for epidemiology/monitoring by the Malaria Division. Drugs prescribed for inpatients are approximately four times more expensive than drugs prescribed for out patients. The cost of drugs for outpatients is 82 Baht relative to the cost by the malaria division;

1.2 Baht for presumptive treatment, 5.9 Baht for the first radical treatment and approximately 54 Baht for the second radical treatment to cases which do not respond to the initial radical treatment.

4.10 Patients Behaviour (Performance)

Performance of operational services in providing radical treatment to positive cases affects the number of days cases may be active carriers (section 4.2.2). Delay in providing diagnosis and radical treatment increases the external costs to patients (Section 3.4) and the overall cost (internal and external) to the community (Section 4.8).

But responsibility for costs does not rest entirely on the Malaria Service. The behaviour or performance of patients in seeking diagnosis and treatment also affect the total cost. If a patient who has malaria fails to ensure that a blood slide is taken and examined immediately after the onset of symptoms, delay has the same effect economically as delay in action by operational services. External costs due to time away from work increase, and the total cost to the community increases.

A study was made to measure the behaviour (performance) of patients attending malaria clinics in Region 1 over a 4 week period in May/June 1982. All positive cases, selected as being representative of the population attending the clinics were interviewed by staff in the malaria clinics using a structured questionnaire.

Time between the onset of symptoms and attendance at a malaria clinic was determined for 3,431 patients. Results yielded a mean of 7.8 days with a standard deviation of 9.6 days.

Given an average time of 7.8 days before seeking diagnosis and treatment means that over a four week period the 3,431 positive patients attending malaria clinics in Region 1 yielded approximately 26,000 man days when patients could be active carriers.

Adding the average time patients take before seeking care to the average time taken by malaria clinics to provide diagnosis and treatment gives an average time of approximately 9 days between the onset of symptoms and provision of radical treatment. This time is still significantly less than the time between taking a blood slide and providing radical treatment through MVV, ACD and VHC services in Zone 3.

The nature of patient performance revealed by this study raises two issues:

i) What will be the total time between onset of symptoms and provision of radical treatment for the other major services; MVV, VHC and ACD?

ii) Since the number of days between the onset of symptoms and provision of radical treatment affects external costs to the patients and increases the probability of collateral cases, what action can be taken to increase the response of patients?

One possibility is to examine the effects of increasing outreach malaria clinics and health education.

4.11 Reliability, Feasibility and Value of Performance Measurement

Results presented in sections 4.1 to 4.10 show that the performance of many aspects of surveillance may be measured: relative effectiveness of case detection, relative contribution of services, time taken to provide radical treatment, performance in house visiting, performance of house visitors, effectiveness in completing examination of blood slides, effectiveness in the identification of positive cases and parasite species, time taken to complete microscopic examination of blood slides and to report results to zone chiefs, effectiveness in case investigation, effectiveness in follow-up, performance in monitoring, efficiency of treatment (cost/patient and cost/positive case), efficiency of malaria clinics (cost/patient), time patients take to seek care.

But several questions remain: (i) how reliable are the results? (ii) Is it feasible for the data required in the measurement of performance to be collected and analyzed by staff in the Malaria Division without the resources of a special research team? (iii) Which (if any) of the performance measures will be particularly helpful to malaria managers in controlling and improving surveillance measures.

4.11.1 Reliability of measurements

The performance of surveillance activities is measured through two sources: primary surveys of processes, personnel, and patients, and secondary surveys of monitoring forms.

Reliability of results from primary surveys is affected by sampling, sample size and procedures used in gathering data. No attempts were made in this study to select samples which were representative of the populations from which samples were drawn. This means that Zones 3 and 7 in Region 1 may not be representative of all zones. Samples taken within the two zones such as measuring the relative effectiveness of case detection and the performance of house visitors may not be representative of the zones. And surveys made of the performance of case detection in outpatient departments of a hospital may not be representative of all hospitals in Thailand.

In an absolute sense the results obtained are not and were not expected to be a reliable measure of the performance of surveillance activities in Thailand. However, every effort was made to ensure that sample size and procedures in gathering data would yield a reliable measurement. In retrospect there are a number of cases where improvements could be made. Advice on procedures which should be followed will be presented in the handbook on "measuring the cost and performance of malaria surveillance activities".

Monitoring forms, records of surveillance activities and action taken over positive cases, provide data for eight of the 13 measurements of performance. Anomalies in data drawn from different sources, incomplete forms and in some cases missing records must cast doubt on the reliability of results drawn from monitoring forms. If monitoring forms are to be used as a major source of data in the assessment of performance, consideration will have to be given to improve the reliability of records.

4.11.2 Feasibility

It may be argued that it is relatively easy for a special research team to investigate the performance of surveillance activities but much more difficult for staff within the Malaria Division to collect and analyze data.

In fact there is no reason why all the surveys of performance should not be undertaken by the Malaria Division provided staff are trained and both the

gathering and analysis of data is carefully managed. For the current study zone staff undertook the primary surveys and students collected data from monitoring forms.

To ensure a thorough and formative approach to the measurement of performance, consideration could be given to assessments being managed by the Research Section of the Malaria Division. The Research Section could manage primary surveys undertaken by zone staff (including training zone staff where appropriate), collate data from monitoring forms (and hence be better informed as to the value of monitoring procedures) and analyze data obtained.

4.11.3 Value of performance measurements

All of the performance measures made (Section 4.1-4.10) provide useful if not essential information in three areas:

i) Review of Procedures
Poor performance in ACD, follow-up, case investigation and monitoring suggests that the procedures should be reviewed and modified.

ii) Planning
Measures such as the relative effectiveness of case detection, relative contribution of services, effectiveness of services in providing radical treatment and patient performance provide, when linked to cost/case and cost/patient, vital information to allow optimum distribution of services and use of resources.

iii) Management
All the performance measurements described allow malaria managers to establish goals, to assess the extent to which targets are achieved and to see how and where efforts should be made to improve the quality of services provided to the public.

5. PROFESSIONAL DEVELOPMENT OF THE RESEARCH TEAM

The third aim of the research study was to contribute to the professional development of a health economics research team at Chulalongkorn University; to extend knowledge, competence and confidence in research.

Health economics is a new area within the University, new in teaching at undergraduate level and new in terms of research. In the absence of formal training in health economics, and in many cases in research, members of the team had to pool their collective knowledge in economics, operational research, medicine and science and learn about health economics and research in health economics through practical experience. A key factor in this professional development has been the cooperative nature of the team.

5.1 The Research Team

The team included the Principal Investigator and three members of staff from the Faculty of Economics, Chulalongkorn University. Two advisors, Dr Somtas Malikul, Thailand and Dr Alan Harding, U.K. provided guidance and help at all stages of the study. Nine students were provided with training through the research programme. The research team, together with student

trainees and advisors provided a most interesting and creative interdisciplinary interaction.

The principal investigator is an economist with degrees in accounting, operational research and economics. Prior to the research study experience had been in teaching economics, posts of responsibility in University Administration, and as Head of a Staff Development Unit. In 1978, three months had been spent in the U.K. in private study of health economics.

The principal investigator was responsible for the major part of the work of the project. Activities included managing the research team, planning, checking and analyzing the work of the researchers and staff, writing of reports (10) and final review of the experience on completion of the project (11). Researchers and student trainees worked in pairs whenever possible. This pairing provided support through stimulation, encouragement and collective responsibility. When collecting data on field trips the team travelled and worked as a group with individuals assigned tasks to maximize utilization of manpower.

5.2 Outcomes

It would be satisfying if outcomes from the research, the professional development of the Principal Investigator, Researchers and student trainees could be quantified and expressed in readily understandable units. In practice measurements are subjective and real gains may not be evident in some cases for many years But some general observations can be made about development which is felt to have occurred.

i) Awareness of Ignorance and Personal Limitations.
The project provided an opportunity to test theoretical knowledge, intellectual abilities and competence in self-management and human relationships. In many cases deficiencies exposed have been rectified. In other cases one is painfully aware that deficiences still exist.

ii) Team Management.
Enhanced sensitivity to the needs of an inter-disciplinary team and knowledge of techniques for generating and maintaining interest and commitment through a 2-year programme.

iii) Project Management.
Enhanced competence in project management; system structure and design, budgeting, accounting and records.

iv) Knowledge and Understanding.
Development of practical rather than theoretical knowledge. This has meant developing more appropriate concepts of costs and performance and recognition of the difficulties of measurement. Also the application of operational research to a new situation.

v) Research Design.
Frequent failures and occasional successes have resulted in greater competence in the design of questionnaires, in issuing instructions and briefing field staff. This has produced a steady improvement in reliability of data.

vi) Publications.
Preparation of progress reports and papers has increased appreciation of the value of writing in stimulating thinking and

generating ideas. Some improvement has also occurred in the writing of papers.

vii) Interdisciplinary contacts among members of the team with staff in the WHO, Malaria Division, Ministries and other universities has produced immense stimulation and a much broader perspective.

viii) A major gain for all members of the team is growth in confidence. Whatever their level of knowledge and ability when the project started, all are now aware that they can do more than they thought if they try.

6. SUMMARY AND RECOMMENDATIONS

6.1 Summary

6.1.1 Aims

The primary aim of the research was to examine HOW to measure the cost and performance of malaria surveillance and monitoring measures. Additional aims were to provide some data on costs and performance which might be used by malaria managers to improve the services and to provide training and experience for members of the research team.

6.1.2 Costs

Micro cost models are developed for the retrospective determination of direct and indirect internal costs for the Malaria and Hospital Services through apportionment of budget expenditure. A range of possible criteria for apportionment are examined and the most suitable selected. Using the selected criteria, the direct and indirect costs of operational units and operational services are determined for two zones in Region 1 of the Malaria Service.

Cost per malaria inpatient and malaria outpatient are also determined for a hospital.

6.1.3 Performance

Techniques for measuring the performance of operational services are explored and performance within the two zones measured. Data are presented on relative performance in case detection; relative contribution of services; time between taking a blood slide and providing radical treatment; effectiveness in providing radical treatment; performance in house visiting; performance of house visitors; effectiveness in completing examination of blood slides; effectiveness in the identification of positive cases and parasite species; time taken to complete microscopic examination of blood slides and report results to sector chief; effectiveness of case investigation and performance in follow-up; performance in monitoring, efficiency of operational services in terms of cost per patient and cost per case, and the internal and total cost per patient in malaria clinics.

Measurements were also made of the time taken by patients between the onset of symptoms and seeking diagnosis.

6.2 Recommendations

6.2.1 Action by the Malaria Division

1. A system for determining costs and performance concurrent with expenditure and events should be introduced on a trial basis in two zones in each of the five regions.

2. Accounting procedures should be reviewed and consideration given to the introduction of programme budgeting. Any developments in accounting procedures should include depreciation of capital investment.

3. Complete and reliable monitoring is fundamental to reliable measurement of performance. The purpose and processes of monitoring should be reviewed and the procedures rigorously supervised. A feasibility study should be made of computerized monitoring with consideration given to management, economic and social implications.

4. Expand the role of the research section of the Malaria Division to undertake systematic analysis of the performance of zones and analyze implications arising from results;

   i) time between taking blood slides and providing radical treatment for the main operation services MC, MVV, VHC and ACD;

   ii) relative contribution of each of the main services to number of blood slides, number of cases and the SPR;

   iii) measure the relative effectiveness of case detection in one area in each of the five regions on an annual basis.

5. The practice of case investigation and follow-up should be reviewed. A clear policy should be established and, if the practice is continued, more attention given to achieving improved performance.

6.2.2 Further Research

Studies should be made of how to reduce costs and increase performance of the major operational services.

1. Agree a target with the Malaria Division for the time between taking a blood slide and providing radical treatment and compare the cost of operational services when achieving this target (cost effectiveness).

2. Determine the external cost of patients using MC, VHC, MVV and ACD services and the effect of location of services on patient performance (time taken to seek care) and demand.

3. Identify what changes to operational procedures could reduce cost/patient, cost/case and external cost/patient for VHC, MVV and ACD.

4. Determine optimum scale and conditions for siting malaria clinics to minimize internal cost and external cost/patient.